THE

AMERICAN NATURALIST.

VOL. XIX.—*MAY*, 1885.—No. 5.

SOME NEW INFUSORIA.

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A BITTER November wind out of a gray sky. A river as gray and cold, a little foam on its surface where the rocks fretted it. A group of bare trees ankle deep in their own leaves on a low bank whence bubbled a rill that seemed the only happy thing in the dreary landscape, while a shivering pedestrian shed involuntary tears as he filled his bottle with wet leaves and with water from the brook. A gloomy prospect and a gloomy day, but for compensation that bottle held a potentiality of infusorial wealth beyond the dreams of avarice. Not a tithe of the wonderful forms developed from the germs in that natural infusion could be noticed without making a paper of wearisome extent. To enumerate the individuals would be impossible. I can only present a half dozen taken at random.

As the infusion stood through the winter in a covered vessel, to which not a single drop of water was added except by the condensation of its own vapor on the cover, a source of endless interest to the writer has been to observe the sudden disappearance of the creatures which, for a week or two, had swarmed among the leaves by the thousand, and the equally sudden coming, from unsuspected and unknown spores, of as great a crowd of entirely different, more complex and more highly organized animalcules. Those higher in the scale devoured the lower, it is true, and did it without ceremony; but many died and melted away as their favorite food became exhausted or, for some other problematic reason, their surroundings became inauspicious. For weeks microscopic fungi flourished until the surface of the water bore a jelly-like layer a quarter of an inch deep, and Hypotrichous Infusoria, so huge that they were distinctly visible to the unaided vision, sported there in leaderless regiments and cohorts. But even that collection of fungi and bacteria disappeared, and the

water at this writing is as clear and limpid and sweet as that of a mountain spring, and not one of those gigantic Hypotricha is left. Yet the bowl is still a crowded infusorial menagerie. And not the least interesting fact is that most of those that have died as well as the living are new to science.

The lowest of those to which I desire now to refer, and perhaps the least abundant in its habitat, is a new member of the genus Atractonema, the threaded spindle, of Stein. Hitherto but one species has been observed, and that only by its discoverer. With it the body is much more fusiform than with this American animalcule, but the latter possesses all the generic characters of its foreign relative, and others which mark it as specifically distinct. The mouth in both is conspicuous, being especially so in this new form. The pharyngeal passage it is scarcely possible to overlook since it seems to communicate directly with the contractile vesicle. Whether the food passes into the pulsating vacuole, or through it, or to one side, are questions of interest that, so far as I am concerned, remain unanswered, as the creature has refused to take food when on the microscope stage. The single flagellum arises within the pharyngeal passage, a point on the wall, presumably the roof, serving as the basis of attachment. This structural feature is not mentioned, and probably does not exist in *Atractonema teres* Stein. The motion of the flagellum is very rapid, consisting of oscillations which give it the appearance of a figure of eight. That it is held stiffly coiled in that position and then vibrated, as is represented in the sketch (Fig. 1), I have been unable to determine. It has been engraved in that position because I desired to show the animalcule in its characteristic swimming attitude. When the Atractonema has been poisoned, preferably by iodine, preferably, of course, so far as the observer is concerned, the flagellum is uncoiled and straightened. The figure of eight aspect may therefore be illusory.

FIG. 1.—*Atractonema tortuosa*, sp. nov.

The animalcule's movements are by rapid writhing and twisting, at the same time rotating on its long axis. It is not changeable in shape, preserving its elongate, subcylindrical, somewhat vermicular form, except when in the agony of a toxicological death. It then coils and contorts itself like a wounded snake, temporarily flattening and expanding the body to a film. The character of the numerous dark-bordered

corpuscles within the endoplasm I do not know. *Chilomonas paramœcium* Ehr., for a long time the prevailing animalcule in the infusion, contains similar bodies which, under the influence of iodine, become intensely blue, and are therefore probably amylaceous. Those within Atractonema, under similar circumstances do not so change. The reproduction of the European species is by longitudinal fission. Multiplication of the American form has not been observed. Fig. 1 and the following description will probably be sufficient for diagnosis:

Atractonema tortuosa, sp. nov.—Body elongate, subcylindrical, soft and flexible but persistent in shape, seven to ten times as long as broad, tapering and pointed posteriorly, the anterior extremity narrowed, the frontal border truncate; oral aperture terminal, conspicuous, followed by a tubular pharyngeal passage apparently connected by its posterior termination with the spherical contractile vesicle; flagellum single, vibratile, about one-half as long as the body, issuing from the oral aperture and taking its origin from the wall of the pharynx at some distance from the frontal margin; nucleus ovate, placed behind the body-center; endoplasm colorless, transparent, enclosing numerous, oblong, dark-bordered corpuscles; movements tortuous and rotatory on the long axis. Length of body $\frac{1}{600}$ to $\frac{1}{325}$ inch. Habitat: a vegetable infusion.

In the *American Journal of Science* for July, 1884, the writer described two new species of fresh-water infusoria under the generic title Solenotus, which was subsequently ascertained to be preoccupied in the Hymenoptera. Consequently, in the August number of the same journal, the name was changed to Notosolenus, the two members of the genus then being *Notosolenus (Solenotus) apocamptus* and *N. orbicularis*. The chief characteristics, aside from the persistent shape and an oral aperture, are the presence of a very short and inconspicuous trailing flagellum on the convex or ventral surface, and a longitudinal depression traversing the dorsal aspect, the infusorian thus appearing to swim on its back, since that part is expected to be more or less convex. Here, however, it is the ventral surface that is rounded.

When these animalcules were first obtained, although an anal aperture was observed and its location recorded, an oral orifice was not noted, and the systemic position of the infusoria was assumed to be among those forms which take food through any point on the surface, and near to Stein's Colponema. Since then, however, numerous specimens of both species have been observed, and although an oral aperture has not been actually discerned, yet the appearance of what seems to be a short pharyngeal tract is so constantly present that an oral orifice probably exists, and

the animalcules must therefore demand admission to the Flagellata-Eustomata of Saville Kent. The indurated character of the cuticular surface and the presence of green particles, apparently of food, within the endoplasm, would indicate the existence of a special mouth which would also be indirectly suggested by the appearance of the anal opening. The place of the genus in a systemic arrangement would therefore probably be, not in the neighborhood of Colponema but near Dujardin's Anisonema, differing from the latter, so far as the flagella are concerned, in having the shorter the trailing one, and the longer the vibratile, the converse of this being characteristic of Anisonema.

In the infusion a third species of Notosolenus has appeared. It is much depressed and almost triangular in form, the sloping sides being somewhat concave or undulate, and the truncate posterior extremity more or less emarginate, this emargination in some individuals increasing to a strongly marked concavity. Fig. 2 represents the creature in its ventral aspect with the extremity moderately uneven, and Fig. 3 another individual with a con-

Fig. 2.

Fig. 3.

FIG. 2.—*Notosolenus sinuatus*, sp. nov., ventral. FIG. 3.—*N. sinuatus*, emarginate form, ventral.

spicuous emargination. Its endoplasm is very bright and transparent, being obscured only in the posterior part by granules and food particles. Its movement is forward in an almost direct course, the body elevated, the anterior apex in contact with the slide, the long flagellum held stiffly and obliquely in advance, its free end only vibrating, while the short flagellum, which appears to be of but little practical advantage to its owner, trails almost motionless below or above, for whether the animalcule shall float with the dorsal surface upward or beneath seems immaterial. It

advances across the field of view, stopping at any collection of débris in its path, examining it for food and departing with sudden turns and reversals of its course. The appearance of a pharyngeal tract is here more clearly defined than in the other species, and the infusorian is by far the largest of those hitherto observed.

Notosolenus (*Solenotus*) *sinuatus*, sp. nov.—Body depressed, broadly and irregularly ovate or subtriangular, somewhat longer than broad, widest posteriorly, gradually tapering through the posterior two-thirds, thence rapidly narrowing to the rounded frontal margin, the lateral borders frequently concave or undulate, the posterior extremity truncate, more or less emarginate; dorsal depression narrow, deep, with an anterior keel-like elevation; ventral surface smoothly convex; long flagellum vibratile at its distal end only, somewhat less than twice as long as the body, held stiffly and obliquely in advance towards the right-hand side; short or trailing flagellum about one-half as long as the body, usually extending obliquely backward toward the right-hand border; nucleus apparently single, spherical and near the center of the left-hand side, the contractile vesicle in front, and near the opposite margin; endoplasm colorless, transparent, posteriorly enclosing granules and green particles. Length of body $\frac{1}{1123}$, greatest width $\frac{1}{1500}$ inch. Habitat: standing water, with dead leaves.

When the growth of fungi and bacteria on the water was near its height, a Paramœcium appeared in profusion. It seems to be a distinct species, and one that can scarcely be mistaken for any known form, except possibly for *P. bursaria* (Ehr.) S. K., differing from the latter, however, conspicuously in form, especially in the apparently oblique curvature of the anterior extremity, in the absence of the truncation of the same part, the absence of the rapid and continuous circulation of the endoplasmic contents, and particularly the green coloration of the cortex and sarcode. The oral aperture of the form I have named *Paramœcium trichium* is at the posterior extremity of the deep adoral fossa which gives the front part the appearance of being folded toward the left, and is followed by a distinct, ciliated pharynx (Fig. 4). The two contractile vesicles, instead of being placed one in each body-half, as in *P. bursaria*, are here anterior and close together, contracting quickly, the one beginning to reform almost before the completion of the other's systole. Trichocysts are very abundant, and are so arranged that they seem to elevate the cuticular surface into the minute hemispherical bosses that cover the entire

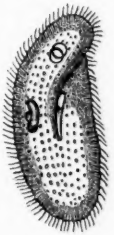

Fig. 4. Fig. 5.

FIG. 4. — *Paramœcium trichium*, sp. nov., ventral. × 450. FIG. 5.—Trichocyst.

body. When forcibly extruded through the influence of the glycerole of tannin, the distal end of each, for about one-tenth of the entire length, is conspicuously thickened, so that the trichocyst seems to be supplemented by the addition of a minute pyramid (Fig. 5). Occasionally, before the animalcule's death, when suffering from the application of a very dilute solution of the glycerole, it then gradually assuming an evenly ovoid form and becoming pale and ghostly, and always after the extrusion of the trichocysts and their removal from the body, the cuticular elevations are replaced by equally minute, regularly disposed, parallelogrammic depressions, as if the escaping trichocysts had left empty spaces which were filled by the sinking of the cortex. The nucleus and nucleolus are not always constant either in relation to each other or to a special part of the body. The former is sometimes, and normally it would seem, subcentrally located, yet sometimes being near the dorsum, again nearest the ventral surface, and still again in the anterior extremity, being seldom seen behind the body center. The laterally attached nucleolus is almost as uncertain in its relative connection with the nucleus, becoming at times entirely detached.

Conjugation has been observed, union taking place between the latero-ventral surfaces. Reproduction is by transverse fission, the nucleus previously becoming much elongated, the dividing plane passing through its center. In some instances, soon after the beginning of genetic union, the nucleus assumes a finely striated appearance, gradually growing more and more indistinct in contour until it finally becomes indistinguishable from the surrounding endoplasm.

Paramœcium trichium, sp. nov.—Body soft and flexible, ovate, somewhat compressed, three times as long as broad, widest and slightly inflated posteriorly, both extremities rounded, the ventral surface somewhat flattened; adoral fossa extending to the center of the ventral aspect from the left obliquely toward the right, deepest and widest anteriorly, this part of the body apparently folded obliquely toward the left-hand side; oral aperture followed by a distinct, tubular, ciliated pharyngeal passage; trichocysts abundant, arranged vertically and apparently elevating the cuticular surface into the numerous, parallel, longitudinal series of minute hemispherical projections roughening the entire body and giving it in optical section a crenulated outline, their distal extremities, when forcibly extruded, conspicuously and pyramidally thickened; nucleus ovate, usually subcentrally placed, with a laterally attached nucleolus; contractile vesicle double, spherical, anteriorly located; anal aperture ventro-terminal. Length of body $\frac{1}{300}$, of trichocysts $\frac{1}{1000}$ inch. Habitat in the jelly-like mass of fungoid and bacterial growth on the surface of an infusion of dead leaves.

Attached to the sides of the vessel, to fragments of leaves or indeed to almost any basis of support, were many mucilaginous, coarsely granular zoocytia formed and inhabited by an animalcule generically distinct from all previously known infusoria. The sheath or zoocytium is very soft and shapeless, and variable both in size and in number of its occupants. It appears to be formed primarily by a thin exudation from the creature's body that would be nearly invisible were it not for the extraneous particles, spores, bacteria and débris of all kinds that adhere to the surface, and especially for the zoöid's excrementitious matter which seems to be the principal building material and the cause of the coarsely granular aspect. It is not uncommon to find a small colony produced by the mutual union, and probably by a mutual formation of adjacent zoöcytia, the resultant of this adhesion being a nondescript mass of flocculent matters from under shelter of which the animalcules project, and when startled by the approach of a larger infusorian, or from other cause, quickly glide backward to the posterior part of their semi-transparent dwelling. These zoöcytia are frequently attached to vegetable fragments or to masses of residual detritus so that they would be an almost indistinguishable part of the granular aggregation were it not for the presence of the living infusorian. Indeed, when deserted these formations cannot be separated by the eye from other flocculent clusters so often in the field. Yet the creature forms them, apparently involuntarily, for soon after a frightened zoöid comes to rest, rejected particles in the food-bearing current begin to mark the outlines of the mucilaginous excretion which soon increases in size by the adhesion of everything that touches it.

The infusoria (Fig. 6) are ovate in form and entirely ciliated. The oral aperture is at the posterior extremity of a median depression occupying the anterior one-third of the ventral surface and bearing on its right-hand margin a row of curved, cirrose cilia. From the frontal border projects a cluster of long, distally curved hairs which by their constant and rapid downward lashing, force a current into the adoral groove and against the row of strong non-vibratile cilia on

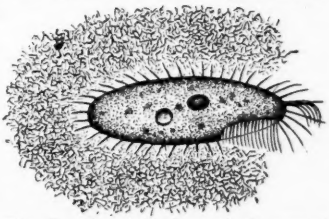

Fig. 6.—*Cyrtolophosis mucicola*, gen. et sp. nov.

the right-hand side of the mouth, thus supplying that ever-ready mouth with food. On such occasions the surface cilia behind the position of the oral aperture are in only irregular and uncertain vibration, while those on the frontal border, including the curved fascicle, are in the most active motion, being only momentarily visible, the right-hand ciliary fringe, under an insufficient amplification, then presenting the aspect of a single short seta, or a narrow lip, projecting from the posterior angle of the excavation. When the zoöids have been for some time under the thin cover, they voluntarily leave the old zoöcytium, swimming rapidly and occasionly settling on the slide to form a new and equally structureless protective covering. If a convenient collection of miscellaneous débris is accidentally encountered, the wandering infusorian often takes refuge beneath it, there gliding backward when threatened, as it did so conspicuously in its original home, the long anterior cilia then streaming out at the front.

Cyrtolophosis (κυρτος, *curved*; λοφωσις, *wearing a crest*), gen. nov.—Animalcules ovate, persistent in shape, entirely ciliate, the adoral cilia differing from those of the general surface, the anterior extremity bearing a fascicle of long distally curved, vibratile hairs; secreting and inhabiting a variously modified, mucilaginous, granular zoöcytium, to which they are in no way attached and from which they may pass at will; oral aperture at the posterior extremity of an excavated, elongated groove, longitudinally traversing the anterior part of the ventral surface, bearing on its right-hand margin a series of cirrose, adoral cilia; nucleus and contractile vesicle single, conspicuous; anal aperture postero-terminal.

Cyrtolophosis mucicola, sp. nov.—Body ovate, two and one-half to three times as long as broad, both extremities rounded, narrowed anteriorly, the ventro-frontal border obliquely truncate; anterior cilia longest, those of the general surface setose, the anteriorly placed fascicle of distally and downwardly curved cilia conspicuous; adoral depression extending from the frontal border for one-third the length of the entire body: adoral cilia cirrose, curved, diminishing in length toward the oral aperture; contractile vesicle single, spherical, posteriorly placed near the right-hand lateral border; nucleus subspherical, subcentrally located. Length of body $\frac{1}{300}$ to $\frac{1}{1000}$ inch. Zoöcytia solitary or variously united. Habitat: an infusion of dead leaves. Reproduction by transverse fission.

Another infusorian, bearing a carapace and having the adoral fringe on the left-hand margin of the peristome, and therefore undoubtedly a member of the Euplotidæ, proved to be an undescribed species of the curious Euplotes, animalcules whose ventral styles are not only used for swimming but as ambulatory organs. They are often seen walking over the slide and among the masses of débris usually present, apparently swimming only when food is exhausted in that locality and they must journey

further to seek it. The form now referred to differs from all others in the number of the frontal styles, the character and arrangement of the anal styles and caudal setæ, and in the shape of the carapace, which has a very conspicuous keel or high acute ridge traversing the dorsum from the frontal to the posterior borders. In Fig. 7 is shown the ventral aspect with the ambula-

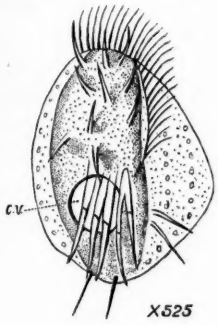

Fig. 7.

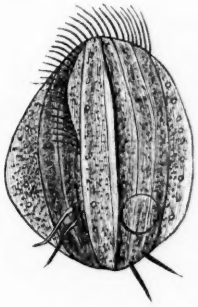

Fig. 8.

FIG. 7.—*Euplotes carinata*, sp. nov., ventral aspect. FIG. 8.—The same in dorsal aspect.

tory organs and setæ; in Fig. 8 the upper surface of the carapace with the central keel that suggested the specific name.

Euplotes carinata, sp. nov.—Carapace irregularly suborbicular, the frontal and right-hand borders evenly rounded, the posterior margin convex and usually emarginate on the right-hand side, the left-hand border rounded but obliquely truncate in opposite directions, thus forming a subcentral rounded protruding angle; dorsal surface traversed by a single conspicuous median and longitudinal keel or acute ridge, and by four to six longitudinal furrows; seven frontal, three scattered ventral and five straight simple anal styles; four unbranched caudal setæ, the two on the left-hand side close together but remote from the margin; peristome-field narrow, arcuate, the posterior third of the right-hand border ciliated; nucleus band-shaped, long, semicircular. Length of carapace $\frac{1}{370}$, greatest width $\frac{1}{500}$ inch. Habitat: standing water with dead leaves.

In the *American Monthly Microscopical Journal* for Dec., 1884, the writer described a Euplotes under the specific title of *plumipes*, so naming it on account of the beautifully fimbriated condition of the anal styles; but the figure there published represented a few of the adoral cilia in an incorrect position. Through the kindness of Dr. Packard I am able to present here a corrected drawing (Fig. 9) of the same interesting infusorian with the description. My pleasure in doing so is increased not only by the

opportunity to correct my own oversight, but because I can again ask attention to one of the most beautiful American members of the genus.

The carapace of *E. carinata* is somewhat irregularly marked by small circles formed of minute dots visible through the transparent borders. This ornamentation is variable, however, as is probably the case in all the decorated species, the dots becoming scattered, leaving the little circles incomplete or even entirely destroying them. This variableness in the surface adornment is also apparent in *E. plumipes*, but there, when most completely developed, the ornamentation consists of oblong elevations arranged in stellate clusters which are sprinkled quite regularly in

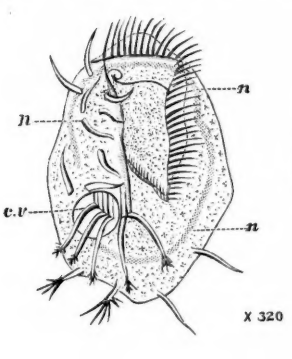

Fig. 9. Fig. 10.

FIG. 9.—*Euplotes plumipes* Stokes. FIG. 10.—Ornamentation of the carapace.

longitudinal lines over a surface already roughened by minute dots. The result is very pleasing to the eye, and adds another item of interest to the infusorian which seems to be one of the bravest and most self-reliant of its class, walking or swimming boldly and steadily forward as if with some object of vital import in view. This ornamentation is shown in detail in Fig. 10.

Euplotes plumipes Stokes.—Carapace irregularly suborbicular or elliptical, the anterior margin truncate, often minutely crenulate or beaded, the upper lip crescentic and conspicuously projecting; posterior margin rounded, usually with a shallow emargination on the right-hand side of the median line; right-hand border rounded or somewhat flattened and undulate; the anterior and posterior halves of the left-hand border commonly obliquely truncate in opposite directions and forming centrally a projecting and rounded angle or keel-like protuberance; peristome field

wide, triangular, the upper right-hand corner prolonged in a sinistrally directed helicoidal curvature, posteriorly extending beyond the center of the ventral surface, the cilia of the anterior and left-hand borders large and cirrose, the posterior third of the right-hand margin ciliated; six frontal, three ventral and five anal styles, the extremities of each of the last finely fimbriated; caudal setæ four, the two on the right-hand side of the median line much branched; dorsal surface convex, without longitudinal furrows, minutely roughened and often ornamented by longitudinal rows of equidistant elevations formed of minute prominences arranged in stellate clusters; nucleus band-like, curved, very long, extending around nearly the entire periphery, its extremities separated by a short interval near the right-hand body margin; anal aperture in close proximity to the contractile vesicle. Length of carapace $\frac{1}{200}$ inch. Habitat: pond water, near the bottom.

Conjugation is accomplished through the union of two individuals by the left-hand half of the ventral surfaces, and multiplication is by transverse fission. The first apparent change preceding the latter act is the development of a series of cilia almost parallel with the left-hand margin of the peristome, while from the comparatively vacant space over which the ventral styles are scattered, the zoöid gradually extrudes fourteen new styles, a second contractile vesicle appears, and the infusorian then presents the interesting aspect of a Euplotes with a double row of adoral cilia, two pulsating vacuoles, four caudal setæ and twenty-eight ambulatory styles. The body quite rapidly elongates until about twice the ordinary length, and separates across the middle, distributing the twenty-eight styles so that the anterior moiety preserves the old frontal and ventral ones, taking five of the new for its anal supply and extruding four fresh caudal setæ. The posterior portion therefore has the newly formed frontal and ventral and the old anal styles, with the old caudal setæ. But before the final separation the posterior animalcule extrudes four additional caudal setæ, then having twice as many as the normal complement, gradually and in irregular sequence absorbing the four old and now unwelcome and useless ones, those that are branched being the last to appear and the last to be absorbed.

KITCHEN GARDEN ESCULENTS OF AMERICAN ORIGIN.

I.

BY E. LEWIS STURTEVANT, M.D.

IN our leading seed catalogues some seventy-two species of plants are usually grouped under kitchen garden esculents. Of these we believe seventeen to be of American origin, the purslane doubtful, and chives to belong to both the old and the new world. Excluding these nineteen, De Candolle assigns, of the remainder, twenty-four to Europe, fifteen to Asia, four to Africa, one to Australasia and nine not mentioned. Of this list many have both European and Asiatic habitat, or other habitat as well as the one under which tabulated. If we compare the importance of the old and new world vegetables, we find it difficult to decide. Certainly the old world cabbage, in its numerous races, is of importance in the garden, but so is the new world potato. What can be decided, however, is that the peppers, pumpkin and squash, tomato, sweet corn and sweet potato are representatives of a culture which antedated their introduction into the gardens of Europeans, and must have been derived through a cultivation as careful as was required for the equal development of similar vegetables of old world origin. To expect to find the original of our longest cultivated vegetable products, as wheat or maize, in a plant that can now be recognized as a wheat or a maize, seems unphilosophical, as evolution must have long since produced changes during that long series of selections that have resulted not alone in producing varieties, but even races which deserve specific discrimination. On account of the light thrown upon an ancient civilization by the knowledge of the cultivated plants it has produced, I have thought fit to bring together a selection from my notes relating to the esculents of American origin which are now to be generally found in our vegetable gardens.

Alkekengi.—The alkekengi, or more usually called strawberry tomato in our seed catalogues, is *Physalis pubescens* L., an American plant which furnishes one of our minor vegetable products. This plant is said by Gray to be common southward and westward in the United States; and it is the *camaru* of Brazil.[1] It is

[1] Masters. Treas. of Bot.

described by Parkinson[1] under the name of *Halicacabum f. alk. virginiense*, and by Feuille[2] under the name of *Alkekengi virginianum fructu luteo*,[3] these names indicating its American origin. *P. peruviana* Hort., the *alkekengi of Peru* or *Capuli*, is cultivated in French gardens, but it differs but slightly from *P. pubescens*.[4] Pickering[5] says it is a native of tropical America, and has a Carib name, *sovsovrov-scoroo* (Desc.), and is called in Tagalo *potocan* (Blanco). Mueller[6] says *P. peruviana* L., is a native of temperate and tropical America, and is now naturalized widely in many countries of the warmer zone, a perennial, but in colder climates an annual. *P. barbadensis* Jacq., is another species sometimes cultivated in France[7] and a native of Barbadoes.[8] *P. mexicana* Vil., probably synonymous with *P. edulis* Sims., is grown in France, and the seed sold under the name of petite tomate du Mexique, according to Vilmorin (l. c.), but as grown at the New York Agricultural Experiment Station, it appears to answer to the description of *P. angulata* L. (var. ? *philadelphica* Gray ?), but the fruit larger than in the description. If this supposition be correct it was mentioned by Camerarius in 1588, Parkinson 1640, etc. Sloane mentions its occurrence in Jamaica.[9] Pickering[10] says it is a native of tropical America, but it seems to have a Malabar name, *inota inodien* (Rheede), Burmese *pungben* (Mason), Ylocano *tuttullacac* (Blanco), on Tahiti *tamani* (Bertero), on the Hawaiian islands *kamani*. Mueller[11] says it occurs in many tropical countries, extending as a native plant to the northern part of the United States and to Japan.

The old world alkekengi is *P. alkekengi* L., well known to the ancients, and described by Dioscorides. It does not now seem to be cultivated as a kitchen garden plant, having been superceded by the American species.

The fruit of the strawberry tomato is much esteemed by some

[1] Theatrum Botanicum, 1640, 462.
[2] Obs. faites sur les cotes orientales de l'Amerique meridionale, Paris, 1714–25.
[3] Miller's Dict.
[4] Vilmorin. Les Pl. Pot., p. 4.
[5] Chron. Hist. of Pl., 755.
[6] Select Plants, p. 165.
[7] Vilmorin. l. c.
[8] Miller's Dict.
[9] Lunan. Hort. Jam., II, 303.
[10] l. c., 429.
[11] l. c., 165.

people in a raw state or in preserves, and is disliked by others. It has a sweet acidulous taste with a pronounced flavor, considered by some as agreeable, by others as nauseous. It was not known in French kitchen garden culture in 1829 (not being mentioned in L'Hort. Francais, 1824–5, Nouv. Dict. du Jard., 1826, nor by Noisette, Man. du Jard., 1829), nor was the seed in the catalogue of Thorburn in 1828, which would indicate that it was not then in American gardens. *P. alkekengi*, according to Loudon,[1] was cultivated in most gardens in England till in the last century, and he says several other hardy species, including *P. pubescens*, also produce edible fruit. Alkekengi is described in several varieties or species by Burr in his American "Garden Vegetables," edition of 1863, but I have no opportunities of library conveniences to establish when our species first appeared in kitchen garden culture.

Bean: Kidney.—We have few vegetables as difficult to trace historically as the common bean (*Phaseolus vulgaris* Savi.), on account of the confusion which exists not only in the vernacular names customarily applied to this group of the Leguminosæ by common people, but also on account of the likeness which appears to exist between *beans* of various botanical genera. In a finely arranged museum collection of substances used in the arts, and arranged by a gentleman of unusual scientific attainments, I very recently was much surprised to recognize the *Soja* bean under the name "Beans from Japan," and also to recognize a variety of Dolichos under a similar mislabeling. The bean serves as a food, and is carried as provision from place to place without destruction of its value as a seed, and hence we should expect a more rapid and less recorded introduction to a new locality than is generally the case with a desirable vegetable, and this quick distribution is illustrated by the mention, by Josselyn, one of the early writers of New England, of the "American beans" of many kinds, and also Bonivis, Calavances and the "*kidney-bean that is proper to Roanoke*," and he adds: "But these are brought into the country; the others are natural to the climate."[2]

In De Candolle's writings upon geographical botany, he seems to ignore authors who might be quoted to fortify an opinion upon the American origin of plants, as his references show dependence

[1] Hort. Lond., 1860, p. 582.

[2] Josselyn's Voyages, pp. 73–74.

more upon botanical writers than upon mention by voyagers and historians. If we peruse the early accounts of American discovery, we find beans mentioned as of almost universal occurrence among the native tribes, but what bean was meant must be inferred from other data. In the north-eastern portion of America it is probable that such mention is of *Phaseolus vulgaris;* in the central portion, of this and some species of the Dolichos; further south, the Dolichos and lima are perhaps often included; in the south-west, the mesquit bean. All these sorts, whichever genus was intended, served as food for the traveler, and were doubtless, all but the mesquit, secured as provision by the many exploring vessels victualed in those times from the productions of the countries visited.

We have absolutely no certain information which leads us to suppose that *Phaseolus vulgaris* existed in the old world before the discovery of America. The only evidence we find is the early use of the word "kidney-bean" by voyagers, as when Columbus, in 1502, found "red and white beans, resembling the kidney-beans of Spain,"[1] but this is in a translation; or when Strachey says the beans of Virginia "are the same which the Turks call garvances;"[2] but Strachey was in Virginia in 1610, and before this the kidney-bean seems well known in Southern Europe. There is no certainty that it was known to the ancient Greeks and Romans. According to De Candolle[3] this bean is not among the numerous seeds that have been unearthed from the ruins of ancient Troy, nor has it been found in the lacustrine débris of the lakes of Switzerland, Savoy, Austria and Italy. There is no proof that it existed in ancient Egypt. It is not mentioned by ancient Chinese authors.[4] The authors of the fifteenth century, such as Crescenzio and Macer Floridus, do not speak of it. The authors of the sixteenth century, after the discovery of America, all publish figures and descriptions of *P. vulgaris* with an infinity of varieties.[5] Kidney-beans are stated to have been introduced into England in 1597, some say imported from the Netherlands as early as 1509.[6] *French beans* are, how-

[1] Knox. Coll. of Voy., 1767, I, 147.
[2] Strachey's Virginia. Hak. Soc. ed., 117.
[3] Origine des Plants Cultivées, 272.
[4] Bretschneider. On the study and value of Chinese botanical works, &c.
[5] De Candolle, l. c., 272.
[6] W. S. Booth, Treas. of Bot.

ever, mentioned by Barnaby Googe in 1572,[1] which name indicates their previous introduction into France. In 1640 Parkinson[2] says in his quaint form: "There hath come likewise unto us and others both from Africa, Brasill, the East and West Indies, Virginia, &c., sundry other sorts and varieties which were endless to recite, or at least useless, but onely to behold and contemplate the wonderfull works of the Creator in those his creatures." The mention of a Faseolus by Albert le Grand, which De Candolle takes to be a dwarf bean, may well apply to some species of Dolichos, probably *D. unguiculatus* L. There is no indication of an early introduction into India, as De Candolle remarks,[3] and Walter Elliot[4] says that *P. vulgaris* is not an article of field produce in Southern India nor of general use among the natives, its culture being confined to gardens near European settlements.

The evidence for the antiquity of the bean in America is both circumstantial and direct. The number of names given in the northern parts of America alone indicate an antiquity of culture, such as *sahe* or *sahu* on the St. Lawrence (Cartier), *ogaressa* by the Hurons (Sagard), *tuppuhguam-ash*, "twiners," by the Northern Algonquins (Elliot), *a'teba'kwe* by the Abenaki of the Kennebec (Rasle), *mushaquissedes* by the Pequods (Pres. Stiles), *malachxil* by the Delawares (Zeisberger), *okindgier* on the Roanoke, etc.; and in these few cases, for illustration, we find no common root. The number of varieties that were grown by the Indians are also another indication of antiquity of culture, but this fact of varieties will receive illustration in our quotations from early voyagers.

John Verarzanno, in a letter written in July, 1524, says of the Indians of Norum Bega: "Their ordinairie foode is of pulse, whereof they have great store, differing in colour and taste from ours, of good and pleasant taste." Evidently this first visitor to the New England coast had never seen kidney-beans previously.[5] In 1605 Champlain, writing of the Indians of the Kennebec region says: "With this corn they put in each hill three or four Brazilian beans (Febues du Bresil), which are of different colors. When they grow up they interlace with the corn which reaches

[1] Gard. Chron., 1864, 1181.
[2] Theatrum. Bot., 1058.
[3] l. c., p. 272.
[4] Bot. Soc. of Edinb., VII, 291.
[5] Hakluyt. Divers Voyages to Am., p. 61.

to the height of from five to six feet; and they keep the ground very free from weeds."[1] In 1614 Capt. John Smith mentions "beans" among the New England Indians,[2] and when the Pilgrims first landed, Nov. 19, 1620, Miles Standish unearthed from a pit not only corn but "a bag of beans." Wood also mentions "Indian beans" as among the foods of the Massachusetts Indians, 1629–33.[3] Lescarbot[4] says that the Indians of Maine, 1608, like those of Virginia and Florida, plant their corn in hills, "and between the kernels of corn they plant beans marked with various colors, which are very delicate: these, because they are not so high as the corn, grow very well among it."[5] The most complete enumeration of varieties are, however, given in Josselyn, before 1670: "French beans: or rather, American beans. The herbalists call them kidney-beans from their shape and effects: for they strengthen the kidneys. They are variegated much,—some being bigger, a great deal, than others; some white, black, red, yellow, blue, spotted: besides your Bonivis and Calavances, and the kidney-bean that is proper to Roanoke. But these are brought into the country; the others are natural to the climate."[6]

In 1535 Cartier, at the mouth of the St. Lawrence, found "beans of every color, yet differing from ours."

In 1609 Hudson, exploring the river which now bears his name, found within the limits of what is now Rensselær county, N. Y., "beans of the last year's growth."[7] In 1653 Van der Donck, in his Description of the Netherlands, says: "Before the arrival of the Netherlanders [1614] the Indians raised beans of various kinds and colors, but generally too coarse to be eaten green, or to be pickled, except the blue sort, which are abundant."[8] In 1633, De Vries "proceeded in the yacht up the [Delaware] river, to procure beans from the Indians."[9]

"Beans" were seen by Newport, in 1607, in ascending the James river,[10] but Heriot, in 1586, describes the *okindgier* of Vir-

[1] Champlain's Voy. Prince. Soc. ed., 64.
[2] The Disc. of New Eng. Peter Force Coll. of Tracts, II, 16.
[3] N. E. Pros., pt. 2, ch. 6.
[4] Hist. Nouv. France, 1612, 835.
[5] Quoted by Gray and Trumbull, *Am. Jour. of Sc.*, Aug. 1883, p. 132.
[6] Josselyn's Voyages, 73, 74.
[7] N. Y. Hist. Soc. Coll. 2d ser., I, 300, 325.
[8] Gray and Trumbull, l. c., 134.
[9] Hazard's Annals of Pa., 31.
[10] Pickering, Ch. Hist. of Pl. 575.

ginia, "called by us beans, because in greatness and partly in shape they are like to the beans in England, saving that they are flatter, of more divers colours, and some pied. The leaf also of the stem is much different."[1] In 1700–8 Lawson[2] says: "The kidney-beans were here before the English came, being very plentiful in Indian corn-fields. The 'bushel bean,' a spontaneous growth, very flat, white and mottled with a purple figure, was trained on poles. [This is undoubtedly the lima, as it answers to the description given to me by a very credible person who secured for me samples from a spontaneous plant in Florida, 'the trunk as large as a man's thigh, and the plant known for the past twenty-five years, some years yielding as much as fifty bushels of pods,' and the seeds smaller than the cultivated lima, very flat, white and mottled with purple.] Indian rounceval or miraculous pulse, so called from their large pods and great increase; they are very good, and so are the bonavis, calavances, nanticokes and abundance of other pulse, too tedious to mention, which we find the Indians possessed of when first we settled in America." [*Bonavis* is perhaps bonavista, a variety of bean sold by Thorburn, a New York seedsman, in 1828. The *bonavista* bean (Long) of Jamaica, is said to be *Lablab vulgaris; calavances* is the Barbadoes name for *Dolichos sinensis* L., as used by Long, a red bean; and *galavangher* pea is the Barbadoes name for *D. barbadensis* Mayc.] In A true declaration of Virginia, London, 1610, p. 12, "the two beanes [planted with the corn] runne upon the stalks of the wheat, as our garden pease upon stickes."

In 1528 Narvaes found beans in great plenty in Florida and westward,[3] and de Vaca found beans in New Mexico or Sonora in 1535. De Soto, 1539, also found beans in abundance,[4] and mentions that "the granaries were full of maes and small beans," but we have no clue to the species. Beans are also mentioned in Ribault's voyage, in 1562, as cultivated by the Florida Indians.

The mentions of beans in Mexico are frequent. The Olmecs raised beans before the time of the Toltecs, as Veytia informs us;[5]

[1] Pinkerton's Voy., XII, 595.

[2] Voyage to Carolina, pp. 76, 77.

[3] Cabeza de Vaca's Relation.

[4] A relation of the invasion and conquest of Florida (no title page).

[5] Hist. Antiq. de Mejico, I, 154.

beans were a product of the Nahua tillage;[1] they are mentioned by Acosta;[2] Alarcon speaks of their culture by the Indians of the Colorado river in 1540; Alvarado of their culture by those of the valley of del Norte in 1541; and Vinegas says *kidney*-beans were grown by the Indians of the Colorado river in 1758. The native Mexican name was *ayacotle*, according to Humboldt, and Bancroft says that they were the "*etl*" of the Aztecs, when boiled in the pod *exotl*.

In November, 1492, Columbus, in Cuba, found "a sort of beans,"[3] or "fields planted with faxones and habas very different from those of Spain,"[4] and red and white beans were afterwards seen by him in Honduras,[5] according to Pickering.[6] Oviedo says in Nicaraugua many varieties of beans are raised,[7] and Gray and Trumbull quote Oviedo as saying that on the island and on the main many bushels are harvested every year, and in the province of Nicaraugua they are indigenous, and a great number of bushels are produced yearly of these and of other *fesoles* of other sorts and different colors.[8]

The Indians of Peru, according to de Vega, had three or four kinds of beans called *purutu*.[9] Squier found lima beans in the mummy covering of a woman from the huaca at Pachacamac, Peru;[10] and Stevenson also found beans in his exploration of Peruvian tombs which antedated the conquest.[11] Wittmack, who studied the beans brought from Peruvian tombs by Reiss and Strobel, identified the lima beans and also three kidney-beans with *P. vulgaris purpurens* Martens, *P. vulgaris ellipticus præcox* Alefield, and *P. vulgaris ellipticus atrofuscus* Alefield.[12]

In Chili Molina says that before the country was conquered by the Spaniards, "thirteen or fourteen kinds of the bean, varying but little from the common European bean, were cultivated by the

[1] Bancroft's Native Races, II, 347.
[2] Hist. de las Zud. Seville, 1590.
[3] Knox Coll. of Voy., I, 83.
[4] Gray and Trumbull, l. c., 130.
[5] F. Colomb., 28 to 90.
[6] Chron. Hist. of Pl., 375.
[7] Hist. Gen., I, 285.
[8] l. c., 131.
[9] Royal Com. Hak. Soc. ed., II, 358.
[10] Peru, 78.
[11] Travels, I, 328.
[12] De Candolle, Origine des Pl. Cult., 278.

natives. One of these has a straight stalk, the other thirteen are climbers."[1]

In the face of this evidence, which might be even more multiplied from my notes, it seems unreasonable in De Candolle to doubt the American origin of the common kidney-bean, and his conclusion as shown by his classing "Haricot Commun Phaseolus vulgaris" under "Especes d'un origine Completement inconnue ou incertaine" seems to show that with him more evidence is required in the case of American plants than to locate others which are of probably European or Asiatic origin.

Bean: Lima.—The lima bean is unquestionably of American origin, and De Candolle assigns its original habitat to Brazil, where the variety *macrocarpus* Benth., has been found growing wild.[2] Seeds have been found in the mummy graves of Peru, as by Squier[3] at Pachahamac, and by Reiss and Stubel at Ancon.[4] In Southern Florida the lima bean, the seeds, white blotched or speckled with red, is found growing spontaneously in abandoned Indian plantations,. and various forms are recorded by authors under specific names as found in America and other countries, as *P. bipunctatus* Jacq., *P. inamoenus* L., *P. puberulus* Kunth., *P. saccharatus* Macf., &c.,[6] *P. derasus* Schrank (Martens), *P. rufus*, Jacq.,[7] etc. In the mentions of beans by voyagers this form is not discriminated from the kidney-bean, and hence we cannot offer precise statement of its occurrence from such authorities.

It is now widely distributed. It has not been found wild in Asia, nor has it any modern Indian or Sanscrit name (De Candolle); Ainslie[8] says it was brought to India from the Mauritius, and is the *vellore* or *duffin bean* of the southern provinces. Wight says it is much cultivated, is seldom if ever found in a wild state, and the large podded sort is said to have been brought by Dr. Duffin from the Mauritius.[9] It is not mentioned by the early

[1] Hist. of Chili, 1, 91.
[2] Orig. des Pl. Cult., 275.
[3] Peru, 78.
[4] De Candolle, l. c., 273.
[5] Letter of W. S. Allen, Chocaluskee.
[6] De Candolle, l. c.
[7] Miller's Dict.
[8] Mat. Med., 1, 28.
[9] Icones Plant. Pl., 755.

Chinese writers,[1] but Louriero mentions it in Cochinchina in his day (1790). A dark red form came to Martens from Batavia, and an orange-red from farther India.[2] Schweinfurth found it in Central Africa,[3] Martens[4] received it from Sierra Leone, the form *bipunctatus* came from the Cape of Good Hope to Vienna,[5] and Martens received it from Reunion under the name *Pois du Cap*. As Jaquin wrote in 1770 this fixes its appearance in Austria, but it only first reached England in 1779.[6] The form *inamœnus* was considered by Linnæus to belong to Africa, but he advances, as De Candolle remarks, no evidence of this habitat, and we may remark that the slave trade may well be responsible for the transmission very quietly of South American species of food plants of convenient characters for ship use to the African coast. *P. derasus* Schrank, considered by Sprengel a variety of *P. inamœnus*, was found at Rio Janeiro.[7]

The lima bean is the scimetar podded kidney-bean and sugar bean of Barbadoes;[8] it was mentioned in Jamaica by Lunan;[9] it may have been "the bushel bean," "very flat, white and mottled with a purple figure," of the Carolinas in 1700–8,[10] as this description applies very closely to the lima beans now spontaneous in Florida. Two varieties, the "Carolina" or sieva and the "lima," were grown in American gardens in 1806. Eight varieties, some scarcely differing, are now offered for sale by our seedsmen: Vilmorin enumerates four for France; the speckled form occurs in Brazil[11] and in Florida; a black form (*P. derasus*) in Brazil; the blood red in Texas;[12] the dark red with light or orange ruddy spots in the Bourbon isles (Jacquin); the black white-streaked in Cochin China (Loureiro); and the large white, small white or sieva, the red, the white striped and speckled with dark red, and the green, in our gardens. In Central Africa but two seeds are

[1] Bretschneider, On the study and value of Chinese botanical works.
[2] Martens, Die Gartenbohne, 96.
[3] Africa, II, 254.
[4] l. c.
[5] Miller's Dict.
[6] Miller's Dict.
[7] Martens, l. c.
[8] Schomburgh, Hist. of Barb., 605.
[9] Hort. Jam., I, 434.
[10] Lawson, Voy. to Car., 76–77.
[11] Martens, l. c.
[12] Martens, l. c.

ever found in a pod,[1] in our most improved varieties five or even six.

Beans: Asparagus.—The asparagus bean has its popular character indicated by its other name, yard-long, indicating the extreme length of its pods, which often attain a length of two feet. It is the *Dolichos sesquipedalis* L., and is said to be a native of the West Indies and of tropical America, and I find no mention of other origin accredited to it. It was included in American seed catalogues in 1828,[2] and was described as a garden plant in America by Fessenden, 1828,[3] and in France by Noisette.[4] It is said to have been first introduced into England in 1781.[5] It may have been the "Indian rouncival, or miraculous pulse, so called from their long pods and great increase: they are very good" of Lawson, 1700–8, found on his journey to Carolina,[6] but the species was not named by Linnæus before 1762, by Reichard before 1772, nor by Jacquin before 1770–6. No varieties are now sold by our seedsmen, nor has any but the original form been described. My notes are very deficient regarding this species.

The name of asparagus bean is probably derived from the lack of membrane, and hence tender character of the pods, which are cooked and eaten as a string bean.

Bean: Scarlet Runner.—The culture of the scarlet runner, *Phaseolus multiflorus* Lam., is very modern. In Johnson's edition of Gerarde, 1630, it is said to have been procured by Tradescant; in Ray's time, 1686, it was grown for ornament; Miller, about 1750, was the first to bring it into repute in England as a vegetable.[7] In America it was mentioned by M'Mahon in 1806[8] as cultivated exclusively for ornament; in 1821 it is included by Thorburn among vegetables,[9] in 1828 the scarlet and white Dutch are both mentioned among garden vegetable seeds,[10] and in 1828 or before, both varieties with white or scarlet flowers were grown in France under the name Haricot d'Espagne.[11]

[1] Schweinfurth, l. c.
[2] Thorburn's Cat., 1828.
[3] New American Gardener.
[4] Man. du Jard., 1829.
[5] Miller's Dict.
[6] Voy. to Car., 76, 77.
[7] Miller's Dict.
[8] Am. Gard. Cal., 1806.
[9] Kalendar, 1821.
[10] Thorburn's Seed Cat., 1828.
[11] Noisette, Man. du Jard., 362.

The species is classed as American by Unger, and is described in 1635 under the name *Phaseolus puniceo flore*, by Jac. Cornuti, in his Canadensium Plantarum Historia, and in 1640 by Parkinson under the name of *P. flore coccineo*.[1] Four forms are described by Martens[2] under *Phaseolus multiflorus* Savi., two of these, the black and the white seeded, were cultivated by Titius in 1654 under the name *P. indicus flore miniato, semine negro* and *semine albo*, the names indicating a West Indian origin; one, the scarlet runner, was first mentioned by Cornuti, 1635; and the fourth, the *P. multiflorus bicolor* Arrabida, was first described in the flora of Rio Janeiro, 1827. It is now grown in gardens in Europe, and is mentioned for India by Firminger.[3]

But three varieties are known to our seedsmen, the scarlet runner, the seeds black mottled with dull lilac; the painted lady, the seeds brown mottled with creamy white; and the white or Dutch with white beans.

Cucumber.—One species of cucumber, *Cucumis anguria* L. (*C. echinatus* Moench., *C. angurioides* Roem., *C. sylvestris americanus, anguriæ folio* Pluk., &c., *C. asininus* Piso, according to Naudin) is considered to be of American origin by botanists from Tournefort down to our own day, and its habitat is given by Naudin as "Antilles, Continental Tropical and Sub-tropical America, Brazil, New Granada, South Florida." De Candolle[4] seems to think its American origin doubtful, and is disposed to refer it to tropical Africa. Naudin, the authority on Cucurbitaceæ, refers to this species the *quarerva ova*, or *C. asininus* of Piso, 1658, found wild in Brazil; Sloane, 1707,[5] evidently describes this or an allied species in Jamaica; Long, 1774,[6] speaks of it as growing wild there, and it is mentioned as growing plentifully there by later writers, as Lunan[7] and Titford.[8] In Barbadoes it is mentioned by Hughes, 1750, under the name "wild cucumber vine."[9]

"Cucumbers" are mentioned by a few of the early writers on American affairs. They were among the plants grown by the

[1] Miller's Dict.
[2] Die Gartenbohnen.
[3] Gard. in India, 151.
[4] Origin of Cult. Plants, 267, 441.
[5] Nat. Hist. of Jam., 1, 227.
[6] Jam., 801.
[7] Hort. Jam., 1, 254.
[8] Hort. Bot. Am., 100.
[9] Schomburgh, Hist. of Barb., 593.

companions of Columbus at Isabella island in 1494,[1] but these were undoubtedly from European seed. De Soto, however, found "Cucumbers better than those of Spain" in his invasion of Florida, 1539;[2] Cartier found "very great cucumbers" cultivated by the Indians at Montreal, 1535, the epithet *very great* indicating the European cucumber however. Perhaps the *cucumbers* cultivated by the Florida Indians, as mentioned by Ribault, 1562,[3] and those seen by Captains Amidas and Barlow in Virginia, 1584,[4] but not those seen in Virginia in 1609,[5] were this species. "Cowcombers" were also planted on the Bermudas in 1609.[6]

The "Concombre arada" is largely cultivated in some of the West Indies, and under the name "West India gherkin" appears in the catalogues of our seedsmen. It seems to have been introduced into French garden culture by Vilmorin in 1858, but it is mentioned as grown in France by Noisette in 1829; it was cultivated in England by Miller in 1753, but probably only as a botanical curiosity. It was in American gardens, as a pickle plant, prior to 1828.[7] The lack of its mention by early writers, and the circumstance of its being reported as wild only in the track of the slave trade, would throw doubts upon its American origin; on the other hand we seem to have fewer specific reasons for assigning its origin to Africa or elsewhere. For the present then it must be considered as an American plant.

Garlic, Leek, Onion, Chives.—Neither the leek, garlic or onion are American plants. It is curious, therefore, to observe that Cortes, on the authority of Humboldt[8] cites onions, leeks and garlic among the edibles found on the march to Tenochtitlan. "Onyons" and "garlicke" are also mentioned by Peter Martyr,[9] and also "Cibaioes and macoanes, like unto onions" in the West Indies.[10] The "wild leekes" formerly eaten by the New England

[1] Irving's Columbus, New York, 1859, I, 380.
[2] Portuguese Relacion, 44, 46.
[3] Hak. Soc. Vol. VII.
[4] Smith's Virginia, 1606, Park. Voy., XIII.
[5] A True Decl. of Va., London, 1610, p. 13.
[6] Newes from the Barmudas, Lond., 1613, 20.
[7] Thorburn's Cat., 1828.
[8] Nouv. Esp., 2d ed., II, 476.
[9] Decades, V, lib. III.
[10] Eden's Hist. of Trav., 1577, 142.

natives[1] is probably *Allium canadense* L., and these are now relished by the Maine Indians. This species also furnishes food to the Indians of the Northwest,[2] and with *A. cernuum* formed almost the entire source of food for Marquette and his party on their journey in 1674 from Green bay to Chicago (to use modern geographical locations). This species does not, however, extend to Mexico, and we do not find mention of species native to the West Indies which would explain P. Martyr's or Cortes' mention, although *A. gracile* Ait., the Jamaica garlic, might answer for one, for these old warriors were not very choice in their application of well-known names to newly discovered plants, if there was any apparent resemblance. We may only suppose that the introduction of these vegetables from the West Indies, where brought by the Europeans, to Mexico, may have preceded the appearance of the Spaniard.

The chives (*Allium schœnoprasum*) occurs in America about Lake Huron, and is also wild in Temperate and Northern Europe, Siberia and Kamschatka.[3]

(To be continued.)

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THE LEMUROIDEA AND THE INSECTIVORA OF THE EOCENE PERIOD OF NORTH AMERICA.

BY E. D. COPE.

TWO distinct divisions are included in this article, because the material is not yet sufficiently complete to enable me to refer certain forms to the one rather than the other. The only characters on which the osteologist can rely in endeavoring to distinguish the two groups are these: First, the terminal phalanges of the Insectivora are compressed and curved, forming claws; while those of the Lemuroidea and of most other Primates are more or less flat, and at the extremity rounded and depressed,[4] or more or less like hoofs.[5] Second, the hallux or inner toe of the posterior foot is opposable to the others, a character dependent on the form of the entocuneïform bone of the tarsus, which has in that

[1] Josselyn's Rarities, 84.

[2] R. Brown, Bot. Soc. of Ed., IX, 380.

[3] De Candolle, Origin of Cult. Pl., 437.

[4] See AMERICAN NATURALIST, April, 1885, where the Condylarthra are referred, with the Quadrumana, to the Ungulata.

[5] The marmosets are exceptions, having true claws.

case a rounded distal extremity, forming part of a cylinder directed more or less fore and aft, for articulation with the metatarsus or proximal element of the great toe. In the Insectivora this structure is wanting, the inner toe being fixed in a position parallel with the others as in the Carnivora. In the Lemuroidea the position of the thumb or pollex is less different from what is seen in the Insectivora, than is the case with the posterior foot. In the true lemur the thumb is but little opposable, except in the genus Chirogaleus and some others. The distal end of the trapezium bone of the carpus with which the thumb articulates, does not form a part of a cylinder in the Lemur or in the Tarsius. When the thumb becomes opposable in the monkey proper, the thumb facet of the trapezium is not rounded, but is wide and a little concave. It is not till we reach the man-like opposable thumb of the anthropoid apes that we find this bone presenting to the thumb a semicylindrical face like that of the entocuneiform bone of the posterior foot.

The Condylarthra as I have pointed out,[1] must be regarded as a division of the order of Taxeopoda, along with the Hyracoidea, the lemurs, the monkeys and man. The difference between the hoofs of Phenacodus and the ungues of Lemur is too slight to admit of wider separation: and the other parts of the structure show an equal agreement. There is no trace of opposability of the hallux in Phenacodus however, nor any os centrale of the carpus, characters which show that the suborder Condylarthra and Lemuroidea are distinct. In the pollex or thumb of Phenacodus, however, there is a distinct indication of opposability, though it is not so well developed as in the genus Lemur. The basal articulation with the trapezium is narrow, but is directed partly fore and aft, so that the thumb looks inwards. Its power of flexure at the base has been slight, but the flexure at the base of the first phalange has been such as to make the end of the thumb quite opposable.[2] From the Condylarthra then we trace the order Quadrumana on the one hand, and the hoofed orders on the other.

In the following pages I will not attempt to distinguish which of the genera are lemuroid and which are insectivorous, since the ungual phalanges are yet unknown. An exception must be made in the case of the genus Pelycodus, where a single compressed

[1] NATURALIST, April, 1885. Primates and Taxeopoda are there regarded as nearly synonymous.

[2] See NATURALIST, 1884, Plate XXIX, for the skeleton of Phenacodus.

acute claw is known. This alone does not decide the question, since such a claw exists on the second toe of many Lemuroidea.

These animals are readily distinguished into three divisions or families by the number of their premolar teeth. There are four such teeth in the Adapidæ; three in the Mixodectidæ, and two in the Anaptomorphidæ. In the Adapidæ we have the most primitive type, and the one most nearly allied to the Condylarthra, from which they were probably derived. In the Mixodectidæ we have the dental formula of the existing lemurs, with a tendency in some of the genera to develop large cutting teeth in the position of incisors, thus approaching the aye-aye. In the Anaptomorphidæ, on the other hand, we find a dental formula like that of the Simioidea and Anthropoidea, or higher

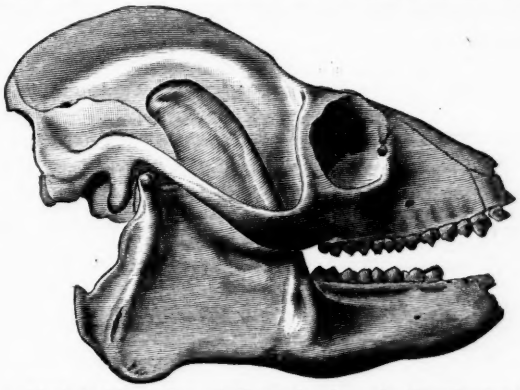

FIG. 1.—*Adapis parisiensis* Cuv., skull nat size, from the Phosphorites of Central France. From Filhol.

monkeys and apes; and in them we seem to get a hint of the derivation of these higher forms, and of man himself.

The genera of the Adapidæ are distinguished by various dental characters. Such are the presence of a second anterior-inner cusp of the inferior true molars; the presence of an internal cusp of the fourth inferior premolar; the number of incisor teeth, and number of single-rooted premolars. The difference between the quadrituberculate and the quinquetuberculate inferior molar may be understood by reference to Fig. 2, where the teeth of the genera Hyopsodus (*a*) and Microsyops (*b*), which represent the two types, are placed side by side.

In some genera, (Notharctus, Tomitherium, Figs. 4–5) the fifth cusp is present but weak. In others (Sarcolemur) it is repre-

sented by the anterior lobe of a twin or fissured anterior inner

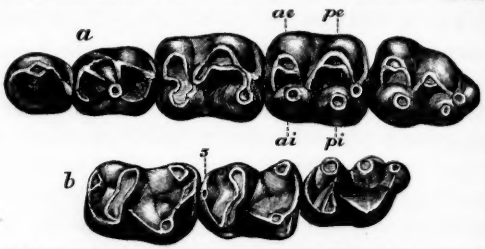

FIG. 2.—Inferior molar teeth of (*a*) *Hyopsodus paulus* Leidy, and (*b*) *Microsyops gracilis* Marsh; enlarged four times linear, from above. Fig. *ae*, anterior external cusp; *pe*, posterior external cusp; *ai*, anterior internal and *pi*, posterior internal cusp; 5 fifth or second anterior internal cusp. From Leidy, Report U. S. Geol. Surv. Terrs., F. V. Hayden in charge, Vol. I.

cusp. To simplify the understanding of these differences, I give the following table:

I. Inferior molars qadrituberculate.

Fourth inferior premolar with internal cusp: cusp on last molar opposite ..... *Hyopsodus* Leidy

Fourth inferior molar without internal cusp; cusps opposite ..... *Apheliscus* Cope.[1]

Cusps of last molar alternate..... *Opisthotomus* Cope.

II. Inferior molars quinquetuberculate.

a. Anterior triangle not well developed on inferior molars.

Fifth cusp separated from anterior inner by an apical fissure only.. *Sarcolemur* Cope.

Fifth cusp separated; canine distinct; one premolar one-rooted.. *Notharctus* Leidy.

Fifth cusp well separated; canine distinct; two premolars one-rooted ..... *Tomitherium* Cope.

Fifth cusp separated, low; canine incisor- or premolar-like..... *Adapis* Cuv.

aa. Anterior triangle well developed on all the inferior molars.

Canine distinct; one premolar one-rooted..... *Pelycodus*[1] Cope.

Jaws of four species of Hyopsodus are abundant in the Wasatch and Bridger Eocene beds, and a species from the Puerco has been doubtfully referred to it. The best known species, the *H. paulus* Leidy (Fig. 2), of the Bridger epoch, has the jaws as large as those of a rabbit. The *H. vicarius* Cope, was smaller (Fig. 3). Nothing is known of the skeleton of any species of Hyopsodus. The only species of Apheliscus (*A. insidiosus* Cope) was found in the Wasatch beds of New Mexico. It has large teeth in the position of sectorials, and may be an aberrant Creodont. Nothing is known of it but jaws. Two species

FIG. 3.—*Hyopsodus vicarius* Cope, jaws, from the Wind River (? Bridger) Eocene of Wyoming, natural size; *a*, superior, *b*, inferior dental series. Original, from Report U. S. Geol. Surv. Terrs., III.

[1] Of uncertain reference to this family and order.

of Opisthotomus are known from the same horizon and locality, from teeth only. The *O. flagrans* Cope is, with the *Adapis magnus* Filh., the largest species of the family. Sarcolemur Cope includes a single species from the Bridger beds, of the size of the *Hyopsodus paulus*. It has in its sharp dental cusps an effective biting apparatus.

In Notharctus Leidy, the fifth lobe of the true molars begins to be apparent, though it is only present in the first molar, where it is represented by the internal extremity of an anterior crest. The canine in this genus is well developed. Only one species is certainly known.

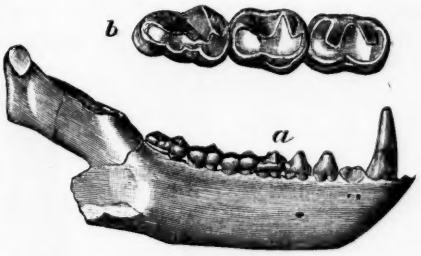

FIG. 4.—*Notharctus tenebrosus* Leidy. *a*, mandible from right side, natural size. Fig. *b*, true molars from above, twice nat. size, linear. From Bridger bed of Wyoming. From Leidy, Report U. S. Geol. Survey Terrs., F. V. Hayden, Vol, I.

More of the skeleton is known in the genus Tomitherium Cope than in any other one of the family, and its relationship to the lemurs was thus indicated at the time of its original description in 1872. Unfortunately the ungual phalanges remain unknown. As in Hyopsodus and Pelycodus, there are but two inferior incisors in the lower jaw, and these have transverse cutting edges, and are not produced as in recent lemurs.

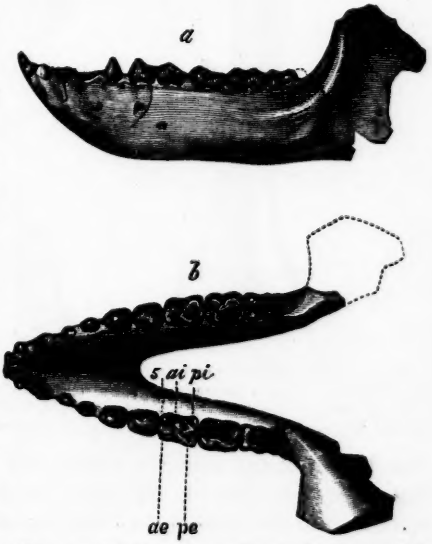

FIG. 5.—*Tomitherium rostratum* Cope, mandible natural size; *a*, from left side; *b*, from above. Letters as in Fig. 2. Original, from Report U. S. Geol. Survey Terrs., Vol. III.

The first impression

derived from the appearance of the lower jaw and dentition, and from the humerus, is that of an ally of the coati (Nasua). The humerus indeed, is almost a fac-simile of that of Nasua, the only difference being a slight outward direction of the axis of the head. The same bone resembles also that of many marsupials, but the flat ilium, elevated position of dental foramen, and absence of inflection of the angle of the lower jaw, etc., render affinity with that group highly improbable.

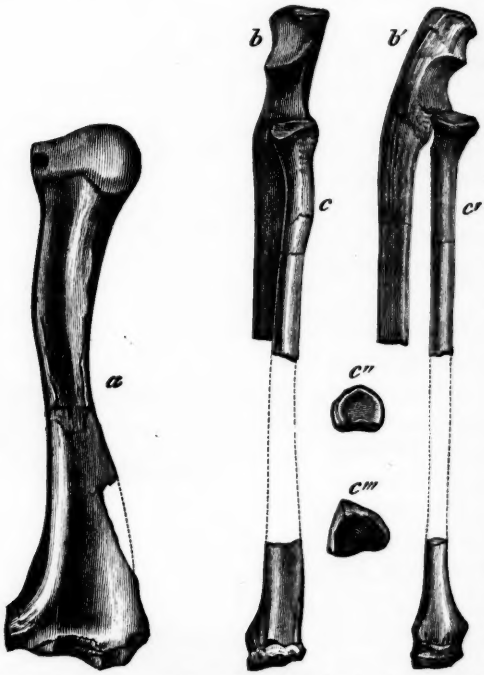

FIG. 6.—*Tomitherium rostratum* Cope, fore leg of animal represented in Figs. 5–7, nat size. Fig. *a*, humerus; *b*, ulna; *c*, radius, from front; *b′*, from side; *c″*, proximal end (artificially flattened below); *c‴*, distal end of radius. From Bridger beds of Wyoming. Original, from Report U. S. Geol. Surv. Terrs., Vol. III.

The length of the femur indicates that the knee was entirely free from the body as in the Quadrumana, constituting a marked distinction from anything known in the Carnivora, including Nasua. The round head of the radius indicates a complete power of supination of the fore foot, and is different in form from that of Carnivora, including Nasua; and, finally, the distal

end of the radius is still more different from that of Nasua, and resembles closely that of monkeys of the genus Semnopithecus.

We have, then, an animal with a long thigh free from the body, a manus capable of complete pronation and supination, and details of lower jaw and teeth quite similar to those of the lower monkeys. The form of the humerus and its relative length to the femur are quite as marked as in some of the lemurs. The most marked difference is seen in the increased number of teeth; but in this point it relates itself to the other Quadrumana, as the most ancient types of Carnivora and Ungulates do to the more modern.

This genus is allied to Adapis Cuvier, of the French Eocene (Fig. 8), but differs in the possession of but two incisors on each side; in Adapis there are three, according to Filhol. From that genus and Opisthotomus, it differs also in the structure of the last inferior molar, as exhibited in the analytical table.

There are several species of Tomitherium, but the

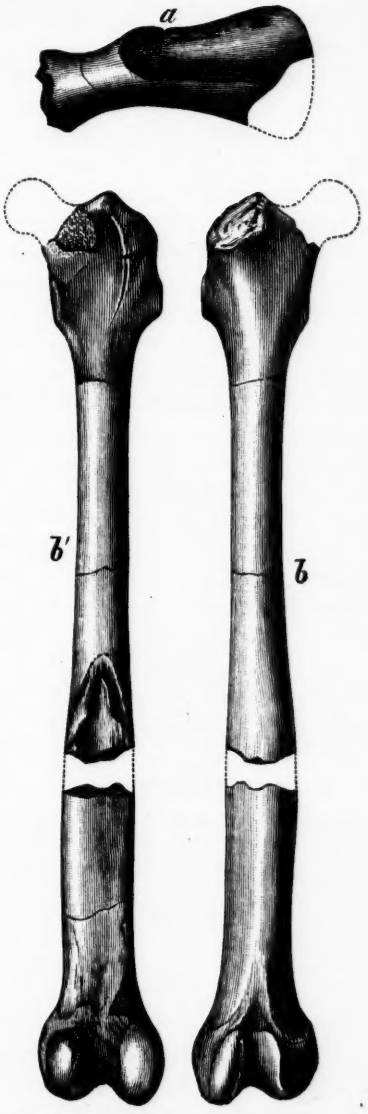

FIG. 7.—*Tomitherium rostratum* Cope, part of animal figured in Figs. 5–6, nat. size. Fig. *a*, ilium inner side; *b*, femur front; *b'*, do. posterior side.

best known is the *T. rostratum* from the Bridger formation of Wyoming.

The following points may be gained by comparison with the skeleton of *Lemur collaris* (catalogue Verreaux). There is considerable resemblance in the details of structure of the molars from the third to the sixth, inclusive. Of course the anterior teeth differ widely in the two, and the last true molar of the Lemur has no heel. The principal difference in the humeri is seen in the superior size of the epicondyles of the *T. rostratum*, and the rather more robust character of the shaft. The proximal half of the ulna is deeper, and the olecranon is not so wide in *T. rostratum*. The proximal part of the radius is very similar in the two species, but the distal extremity is in the *T. rostratum* less transversely extended, and thicker anteroposteriorly. There is also much similarity in the ilia. The crest is more extensive in *T. rostratum*, and the inferior border is thinner at its proximal part. Towards the acetabulum the increase in width of this border is similar, and the anterior inferior spine is as prominent. The resemblance between the femora amounts to identity of character; that of the *T. rostratum* is more robust.

The Mixodectidæ include four and perhaps five genera. In

FIG. 8.—*Necrolemur antiquus* Filh., skull natural size, from Phosphorites of Central France. From Filhol Rech. s. les Phosph. de Quercy.

two of these the incisors have their usual position and space. One of these Tricentes Cope, has large canines well separated. It is uncertain whether the genus should not really be referred to the Creodonta.[1] It contains three or four rather small species from the Puerco formation of New Mexico. In Necrolemur the canine is insignificant. One species of the genus, the *N. antiquus* Filhol, is known. It is represented by a cranium in excellent preservation (Fig. 8) which has been fully investigated by Filhol. This able palæontologist regards it as most nearly allied to the genus Galago now existing in Africa. It furnishes conclusive evidence of the former existence of lemurs in France.

[1] See NATURALIST, 1884, p. 353.

Of the three genera with very large incisor (? canine) teeth, Mixodectes has the last lower premolar with a simple cusp. There are two species from the Puerco beds. The smaller of these, *M. pungens* Cope (Fig. 9), is about the size of the kit fox. Its premolars are of irregular size. In the two other genera the fourth premolar has a second cusp on the interior side of the principal one. Both have the crowns of the inferior true molars composed of two triangles as in Mixodectes and Pelycodus. In Microsyops Leidy, there is but one one-rooted premolar. There are three species from the Wasatch and Bridger beds. The type is the *M. gracilis* Marsh (Fig. 2*b*), from the latter. It was a small animal, not exceeding a gray squirrel in dimensions. In Cynodontomys the premolar teeth are more reduced in size than in any of the allied genera, two of the three being one-rooted. The large ? incisor tooth has a correspondingly large development. The species was found by Mr. Wortman in the Wasatch beds of the Big Horn basin, Wyoming Terr.

FIG. 9.—*Mixodectes pungens* Cope, lower jaw right ramus, natural size. Fig. *a'*, from above. Original, from Vol. III Report U. S. Geolog. Survey Terrs.

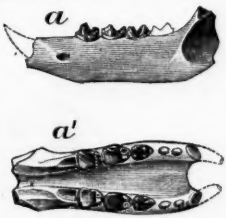

FIG. 10.—*Cynodontomys latidens* Cope, mandible, nat. size, from Wasatch beds of Wyoming. Fig. *a'*, from above. Original, from Report U. S. Geol. Surv. Terrs., Vol. III, F. V. Hayden in charge.

The most evident lemuroids yet found in America belong to the family of the Anaptomorphidæ. But one genus is certainly known to belong to it, Anaptomorphus Cope. The genus Indrodon[1] resembles it in dental formula excepting in the possession of three instead of two incisors. It embraces but one species, *I. malaris*, which was found by David Baldwin in the Puerco formation of New Mexico.

Anaptomorphus was founded on the lower jaw of a small species, *A. æmulus* Cope, which does not exceed that of a ground squirrel (Tamias) in size (Fig. 11). It agrees with a very few of the living lemurs (Indrisinæ) in the number of its teeth, but it differs from them all in having short erect incisor teeth as in the higher monkeys. The molar teeth known are a good deal like those of

[1] Proceedings American Philosophical Society, 1883, p. 318.

the true monkeys in character, being quadrituberculate. The last premolar is quite different, having a compressed, simple, cutting crown. The canine is quite small, and there is no diastema. The evidence furnished by this jaw was happily supplemented by the discovery, at a later day, of an almost entire cranium of a closely allied species in the Wasatch beds of Wyoming by Mr. J. L. Wortman. The species it indicated is rather larger than the *A. æmulus*, and I gave it the name of *A. homunculus* (Fig. 12).

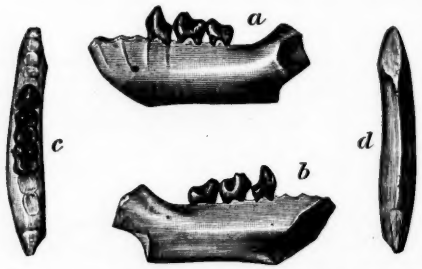

FIG. 11.—*Anaptomorphus æmulus* Cope, left ramus of mandible, twice natural size, linear; *b*, inner side; *c*, from above; *d*, from below. From Bridger bed of Wyoming. Original.

The characters of this genus now known warrant us in thinking it one of the most interesting of Eocene Mammalia. Two special characters confirm the reference to the Lemuroidea which its

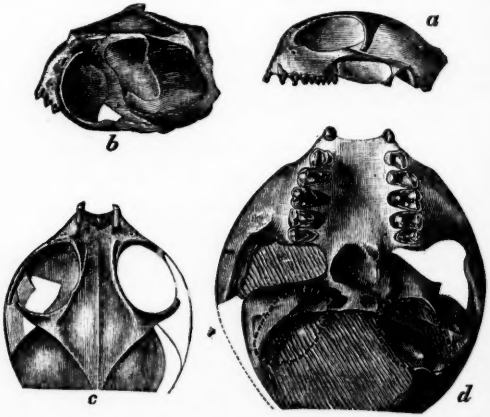

FIG. 12.—*Anaptomorphus homunculus*, skull, natural size except Fig. *d* which is one-half larger than nature, from the Wasatch beds of the Big Horn, Wyoming. Fig. *a*, right side of skull; *b*, oblique view of same showing outline of cerebral hemisphere, postorbital arch removed; *c*, same from above; *d*, the same from below, enlarged one-half, the dotted lines indicate the form of the otic bullæ. Original, from Report U. S. Geol. Survey Terrs.. III, F. V. Hayden in charge.

physiognomy suggests. These are the external position of the

lachrymal foramen and the unossified symphysis mandibuli. Among Lemuridæ its dental formula agrees only with the Indrisinæ, which have, like Anaptomorphus, two premolars in each jaw. But no known Lemuridæ possess interior lobes and cusps of all the premolars, so that in this respect, as in the number of its teeth, this genus resembles the higher monkeys, the Simiidæ and Hominidæ more than any existing member of the family. Of these two groups the resemblance is to the Hominidæ in the small size of the canine teeth. It has, however, a number of resemblances to Tarsius, which is perhaps its nearest ally among the lemurs, although that genus has three premolars. One of these points is the anterior extension of the otic bullæ, which is extensively overrun by the external pterygoid ala. A consequence of this arrangement is the external position of the foramen ovale, just as is seen in Tarsius. Another point is the probably inferior position of the foramen ovale. Though this part is broken away in the cranium of *Anaptomorphus homunculus*, the paroccipital process is preserved, and has the position seen in Tarsius, as distinguished from the Indrisinæ, Lemuridæ, Galaginæ, etc. In this it also resembles the true Quadrumana.

When we remember that the lower Quadrumana, the Hapalidæ and the Cebidæ, have three premolar teeth, the resemblance of Anaptomorphus to the higher members of that order is more evident. The brain and its hemispheres are not at all smaller than those of the Tarsius, or of the typical lemurs of the present period. This is important in view of the very small brains of the flesh-eating and ungulate Mammalia of the Eocene period so far as yet known. In conclusion, there is no doubt but that the genus Anaptomorphus is the most simian lemur yet discovered, and probably represents the family from which the anthropoid monkeys and men were derived. Its discovery is an important addition to our knowledge of the phylogeny of man.

The *Anaptomorphus homunculus* was nocturnal in its habits, and its food was probably like that of the smaller lemurs of Madagascar and the Malaysian islands. Its large orbits and large otic bullæ indicate great acuteness of the senses of sight and hearing. Its size is a little less than that of the *Tarsius spectrum*.

In Pelycodus we have a more decidedly insectivorous type of dentition in the lower jaw, although that of the upper jaw (Fig. 1) has a lemurine character. Enough of the poste-

rior foot is known to show that its structure is like that of Condylarthra, lemurs and the majority of the Insectivora (Figs. 14, 15, 16). The quadrituberculate superior molars (Fig. 1) forbid the reference of the genus to the Creodonta, and if all the ungues are like that represented in Figs. 11 *d*, it cannot be placed in either the Lemuroidea or Condylarthra, but is an insectivore more or less allied to the East Indian Tupæa. The ankle joint (Fig. 14) is flat, or without trochlea. The head of the astragalus is simple and convex, and is prolonged beyond the calcaneum, giving space for a rather long cuboideum. The lower end of the fibula is large (Fig. 15 *b*) and is extensively applied to the astragalus.

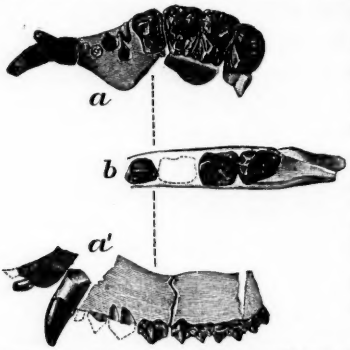

FIG. 13.—*Pelycodus tutus* Cope, portions of skull, from the Wasatch epoch of Wyoming, natural size. Fig. *a*, superior dentition from below; *a'*, the same, external view; *b*, inferior molars 4–6 and 7, from above. Original from Report U. S. Geol. Survey Terrs., III.

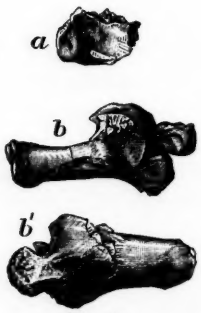

Fig. 14.

Fig. 15.

FIG. 14.—*Pelycodus jarrovii* Cope, ankle joint, nat. size. Fig. *a*, distal extremity of tibia; *b*, astragalus and calcaneum, external view; *b'*, do., internal superior view. From Wasatch bed New Mexico. Original, from Report U. S. Geol. Survey W. of 100th meridian.

FIG. 15.—*Pelycodus jarrovii* Cope, individual represented in Fig. 14, nat. size. Fig. *a*, head of radius; *b*, distal end of fibula; *c*, patella; *d*, entocuneiform, outer side, *d'*, inner side, *d''*, distal end. Original, from Report U. S. Geol. Survey W. of 100th mer., G. M. Wheeler.

The entocuneiform bone (Fig. 15 *d*) shows clearly that the hallux

was not opposable, a character which adds weight to those already mentioned which indicate that the true place of this genus is in the insectivorous order. The large patella (Fig. 15 *c*) shows that the genus is not marsupial. The head of the radius (Fig. 15 *a*) is an oval, agreeing in this with the orders mentioned, excepting the Lemuroidea, and showing that the supination of the manus could be only imperfectly or not at all performed.

But three species of Pelycodus are known, and these are confined to the Wasatch bed of New Mexico and Wyoming. Two species formerly referred here have been separated under the name Chriacus and placed in the Leptictidæ of the Creodont suborder.[1]

The family of the Arctocyonidæ includes more or less carnivorous animals with quadritubercular true molars above. The known genera, of which there are four, possess large canine teeth and quadritubercular inferior molars. The bones of Arctocyon have been described by Lemoine, so far as known, and they are like those of Creodonta, having a flat astragalus and an epicondylar foramen of the humerus. Their quadritubercular superior molars place them in the Insectivora as I have defined that suborder.[2] *Arctocyon primævus* Blv., is a celebrated fossil of the Suessonian beds of France. The single species of Hyodectes and Heteroborus are each from the Puerco beds of France. In America the family is represented by the genus Achænodon Cope, of which three species are known according to Osborn. The dentition is somewhat suilline in character, and Mr. Osborn has accordingly referred the genus to the suilline Artiodactyla. As none of the bones of the skeleton are known, the question remains unsettled. The anterior crest of the glenoid cavity grasps the condyle of the lower jaw as in a carnivorous animal,

FIG. 16.—*Pelycodus tutus* Cope, bones of digit found loose but together. Fig. *a*. metapodial; *b*, first, *c*, second, and *d*, ungual phalanges; *d'*. side, and *d''*, proximal end, nat. size. From Wasatch bed of New Mexico.

[1] See NATURALIST, 1884, pp. 348–352.

[2] Report U. S. Geol. Survey Terrs., III, p. 739.

but the character is also found in the peccary. The typical species, *A. insolens* Cope (Fig. 17), is as large as the largest bears. The *A. robustus* Osborn, is about the same size. A large part of the skull has been discovered. This displays a very high sagittal

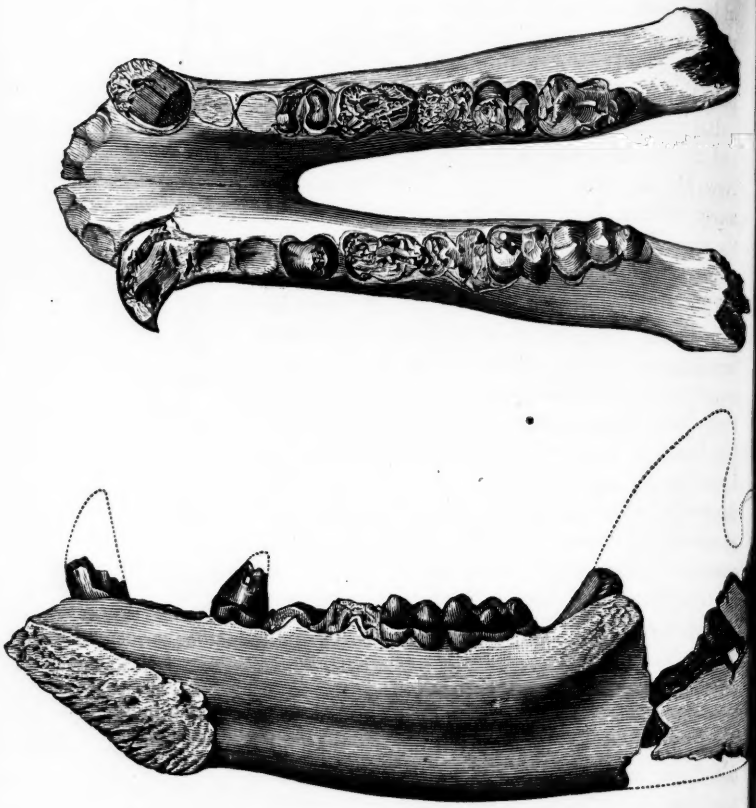

FIG. 17.—*Achænodon insolens* Cope, lower jaw, three-eighths nat. size, from above, and right ramus from inner side. From Bridger epoch of Wyoming. Original, from Vol. III Report U. S. Geol. Survey Terrs., F. V. Hayden in charge.

crest and a very small space for a brain. Its brain was probably of a low type, as has been shown to be the case in Arctocyon by Gervais. In that genus the hemispheres are smooth and very small, leaving the olfactory lobes and cerebellum entirely un-

covered. The resemblance to the brain of the opossum is well

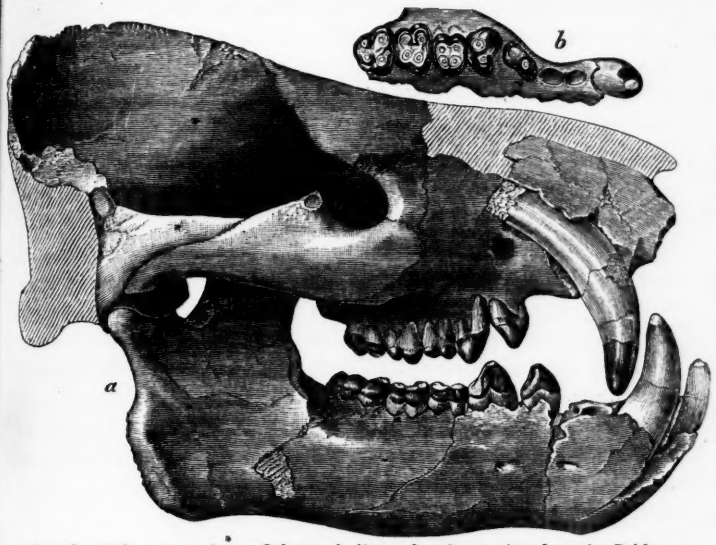

FIG. 18.—*Achænodon robustus* Osborn, skull one-fourth nat. size, from the Bridger bed of the Washakie basin, Wyoming. Fig. *b*, maxillary bone with teeth from below. From Osborn, Bulletin No. 3, E. M. Mus. Princeton College.

marked. In *Achænodon robustus* the orbit is small, indicating comparatively imperfect powers of vision (Fig. 18).

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NOTES ON THE LABRADOR ESKIMO AND THEIR FORMER RANGE SOUTHWARD.

BY A. S. PACKARD.

IT is not my purpose to give an account of the Labrador Eskimo, but simply to put together what I have found in relation to them in works referring to Labrador, and to add a few notes made during two summers spent on that coast in 1860 and 1864. Although I was aware that the Eskimo formerly lived as far south as the southern entrance to the Straits of Belle Isle, where I saw two individuals in 1860, one said to be a full-blooded Eskimo woman, I regarded them as stragglers from the north. It now seems more probable, from the Rev. Mr. Carpenter's statement, to be hereafter given, and from the fact, to be hereafter stated, that several hundred Eskimos lived at

Chateau bay, opposite Belle Isle, in 1765, while others were known to have extended as far east as the Mingan islands, that this race had a more or less permanent foothold on the northern shores of the Gulf of St. Lawrence. If this was so, it seems not improbable but that this roving race may have made, in very early times, expeditions farther south to Nova Scotia and New England. Here also comes to mind the theory of Dr. C. C. Abbot, that the Eskimo formerly inhabited the coast of New Jersey during the river terrace epoch.

Although at first disposed to reject such an assumption, the examination we have made leads us to look with more favor upon Dr. Abbot's theory, and to think it not improbable that long after the close of the glacial period, *i. e.*, after the ice had disappeared and during the terrace epoch, when the reindeer and walrus lived as far south as New Jersey, that the Eskimo, now considered so primitive a race, perhaps the remnants of the Palæolithic people of Europe, formerly extended as far as a region defined by the edge of the great moraine; and as the climate assumed its present features, moved northward. They were also possibly pushed northwards by the Indians, who may have exterminated them from the coast south of the mouth of the St. Lawrence, the race becoming acclimated to the arctic regions. All these hypotheses came up afresh in our mind last summer when we began to collect these notes. Their substantiality became more pronounced after reading the confirmatory remarks made by Professor E. B. Tylor at the Montreal meeting of the British Association. We are not now, however, prepared to adopt the view that the Norsemen did not go as far south as Narragansett bay, and that the natives they saw were not red Indians, their word "skralings" being indiscriminately applied to any of the native tribes they saw. Two voyages from Labrador to New England, not far possibly from the route taken by the Norsemen, lead us to think that their vessels, with fair winds, actually did sail a thousand miles to Cape Cod from Southern Labrador or Newfoundland in nine or ten days. We have made the trip from Cape Cod to the Gut of Canso in about two days, the time given in the Norsemen sagas; but we do not intend at this time to touch upon this attractive subject.

We do find, however, unexpected confirmation of Professor Tylor's supposition that "Eskimos eight hundred years ago, be-

fore they had ever found their way to Greenland, were hunting seals on the coast of Newfoundland, and caribou in the forest," for these events did actually happen in Newfoundland, or at least there are traces of Eskimo residence in large numbers at Chateau bay in 1765, of their repeated crossing over to Newfoundland, and of their learning a few French words from the French settlers.

At all events the facts we here present should induce our New England and Canadian archæologists to make the most careful examination of the shell-heaps about the mouth of the St. Lawrence, and on the shores of Northern and Southern Nova Scotia, as well as Maine and Northern Massachusetts for traces of Eskimo occupation.

Facts seem to confirm the early belief of the Greenland Danish and Moravians that the Labrador Eskimo were an older people than those who migrated into Greenland. In the extracts from the appendix to Cranch's History of Greenland given farther on, we shall see that the Eskimo of these two regions differed in their dress and kayaks, differences we have personally noticed.

Whether the Labrador Eskimo are an older stock than those living directly north of Hudson's bay we cannot say. Crantz, however, remarks: "As early then as the year 1800 our missionaries learned from the reports of Northlanders, who visited their settlements, that the main seat of the nation was on the coast and islands of the north, beyond *Cape Chudleigh*." Crantz, in a note, (xvi) also claims: "There can be no hesitation in affirming that Greenland was peopled from Labrador, not Labrador from Green land."

The theory that the Eskimo entered America by way of Be ring strait, now generally received, was thus stated by Crantz in 1767: "Our Greenlanders it should seem having settled in Tartary after the grand dispersion of the nations, were gradually impelled northward by the tide of emigration, till they reached the extreme corner of Kamtschatka, and finding themselves disturbed even in these remote seats, they crossed the strait to the neighboring continent of America. * * * Our savages then retired before their pursuers across the narrow strait, either by a direct navigation, or by a more gradual passage from island to island, to America, where they could spread themselves without opposition through the unoccupied wastes round the south-east part of Hudson's bay, or through Canada up to the northern ocean. And

here they were first met with in the eleventh century by the discoverers of Wineland. But when they were compelled to evacuate these possessions likewise, by the numerous tribes of Indians superior to themselves in strength and valor, who thronged to the north out of Florida, they receded nearer to the pole, as far as the 60th deg. Here Ellis in his voyage to Hudson's bay found the Esquimaux,[1] resembling the Greenlanders in every particular of dress, figure, boats, weapons, houses, manners and customs. * * * The clerk of the *California*[2] says that these Esquimaux are grievously harassed by the Indians inhabiting the south and west shores of Hudson's bay, who are in all respects a distinct race. An unsuccessful hunting or fishing expedition is a sufficient pretext for their oppressors to fall upon them and take them prisoners or murder them. These acts of violence have induced the fugitives to retreat so far to the northward ; and part of them in all probability passed over to Greenland in the fourteenth century, either crossing Davis's strait in their boats from *Cape Walsingham*, in lat. 66° to the South bay, a distance of scarcely forty leagues, or otherwise proceeding by land round the extremity of Baffin's bay, where, if we may trust the reports of the Greenlanders, stone-crosses, like guide-posts, are still to be seen at intervals along the coast."

That the Eskimo were more abundant on the eastern shores of Hudson's bay may be proved by the following extracts from Coats' Notes on the geography of Hudson's bay, reprinted by the Hakluyt Society.[3] It appears from his notes that the Eskimo inhabited Labrador from the Gulf of St. Lawrence around to James bay, *i. e.*, as far south in Hudson's bay as Belcher's island (lat. 56° 06′) and the Sleepers. Their southern range was probably Hazard gulf, in lat. 56° 22′ ; the coast of Hudson's bay is wild and barren, with floating ice. Speaking of the barren, treeless coast from Cape Diggs to Hazard gulf, Coats says: "Doubtless the native Usquemows know the time and seasons of those haunts, and nick it, for we found vestiges of them

[1] Charlevois derives this name from the Indian word *Eskimantsik*, which in the language of the Abenaquis signifies *to eat raw;* and it is certain that they eat raw fish.

[2] Account of a voyage for the discovery of a north-west passage, Vol. II, p. 43.

[3] Notes on the Geography of Hudson's bay, being the remarks of Capt. W. Coats in many voyages to that locality between the years 1727 and 1751. Edited by John Barrow. London, Hakluyt Society, 1852. 8vo.

at all the places we stopt att." From the foregoing extract it is obvious that Capt. Coats obtained his knowledge of the Labrador Indians and the Eskimo from his personal observations and inquiries while in Hudson's bay; he personally only by hearsay received information that the Eskimo, by whalers called "Huskies," lived as far south as St. Lawrence bay; but his statement will be seen to be confirmed by Crantz. The northern Indians mentioned by Coats are undoubtedly the Naskopies.

The following extracts from the appendix to Crantz' History of Greenland, English translation, fully prove that several hundred Eskimo spent the summer at Chateau bay opposite the north-eastern extremity of Newfoundland, and also crossed over to the latter island, and must have been, for several years at least, residents on the shores of the Strait of Belle Isle. The first visit of the Moravians to the Labrador coast was in 1752; Christian Erhard, a Dutchman, but a member of the Moravian society, landed, in July in Nisbet's haven, with a boat's crew of five men at a point north of this harbor, where all were murdered by the Eskimo, the vessel returning to England. The next attempt to approach the Eskimo was made in 1764, by Jens Haven, who had labored for several years as a missionary in Greenland, and had recently returned with Crantz to Germany. With letters of introduction to Hugh Palliser, Esq., the governor of Newfoundland, in May of the same year he arrived at St. Johns; "but he had to meet with many vexatious delays before he reached his destination, every ship with which he engaged refusing to land for fear of the Esquimaux. He was at length set on shore in Chateau bay, on the southern coast of Labrador; here, however, he found no signs of population except several scattered tumuli, with the arrows and implements of the dead deposited near them. Embarking again he finally landed on the Island of Quirpont or Quiveron, off the north-east extremity of Newfoundland, in the Strait of Belle Isle, where he had the first interview with the natives. "The 4th September," he writes in his journal, "was the happy day when I saw an Esquimaux arrive in the harbor. I ran to meet him and addressed him in Greenlandic. He was astonished to hear his own language from the mouth of an European, and answered me in broken French." The next day eighteen returned his visit. On the third day the Eskimo left the harbor altogether, and after a short stay at Quirpont, Haven returned to Newfoundland.

The following year Haven, with three other missionaries, landed, July 17, 1765, in Chateau bay, lat. 52°, on the south shore of Labrador, opposite Belle Isle. "Here the party separated; Haven and Schlötzer engaging with another vessel, to explore the coast northwards; they did not, however, accomplish anything material in this expedition, nor did they meet with a single Esquimaux the whole time. Drachart and John Hill remained in Chateau bay, and were fortunate enough to have the company of several hundred Esquimaux, for upwards of a month; during which period they had daily opportunities of intercourse. As soon as Sir Thomas Adams had received intelligence that they had pitched their tents at a place twenty miles distant, he sailed thither to invite them, in the name of the governor, to Pitts harbor. On the approach of the ship the savages in the kajaks hailed them with shouts of Tout camarade, oui Hu! and the crew returned the same salutation. Mr. Drachart did not choose to join in the cry, but told Sir Thomas that he could converse with the natives in their own language. When the tumult had subsided he took one of them by the hand and said in Greenlandic "We are friends." The savage replied, "We are also thy friends."

Crantz then describes from the notes of Haven and Drachart, the peninsula of Labrador and some of the animals as well as the habits of the Eskimos. These people remained at Chateau bay through the summer until at least after the middle of September, as on Sept. 12th and 13th the shallop ran ashore, and the Eskimo invited them to lodge in their tents, carrying the missionaries ashore on their backs.

The following extract shows that the Eskimo must, before the year 1765, have been in the habit of crossing the Straits of Belle Isle and landing on Newfoundland:

"The governor wished to prevent them from crossing over to Newfoundland, where, according to their own account, they procured a certain kind of wood not to be found in their country, of which they made their darts. But since they interpreted this prohibition as a breach of peace, it was rescinded, on their promise to commit no depredation on the fishing vessels they might meet with on the way; to which engagement they scrupulously adhered."

The account then goes on to say that during the interval which occurred between the visit of Haven and Drachart in 1765 and

the foundation of the first missionary settlement at Nain in 1771, "the old quarrels between the natives and the English traders were resumed; and as no one was present who could act as interpreter and explain the mutual grounds of difference, the affair terminated in bloodshed. Nearly twenty of the natives were killed in the fray, among whom was Karpik's father; he himself, with another boy and seven females, were taken prisoners and carried to Newfoundland. One of these women, of the name of Mikak, and her son, were brought to England, where they recognized an acquaintance in Mr. Haven, who had formerly slept a night in their tent. Karpik was detained by Governor Palliser, with the intention of committing him to the care of Mr. Haven, to be trained up for usefulness in a future mission to his countrymen. He did not arrive in England till 1769, at which time he was about fifteen years old." He died in England of small-pox.

We glean a few more items from Crantz regarding the distribution, numbers, and habits of the Labrador Eskimos. The Moravians, after founding Nain (lat. 56° 25′), determined to found two other stations, one to the north and the other to the south. Okkak (150 miles north of Nain in lat. 57° 33′) was thus founded on land purchased from the Eskimo in 1775, Haven with his family establishing himself there the following year. The reason for founding these stations was for the reason that it "was found insufficient to serve as a gathering place for the Eskimo dispersed along a line of coast not less than six hundred miles in extent, especially as it afforded but scanty resources to the natives during the winter season, when they had fewer inducements to rove from place to place."

In the summer of 1782 the Moravians began a third settlement to the south, "on the spot which they had formerly marked out and purchased from the Esquimaux. This station received the name of Hopedale." As obstacles to the missionary work were the following: "The spirit of traffic had become extremely prevalent amongst the Southern Esquimaux, the hope of exaggerated advantages which they might derive from a voyage to the European factories, wholly abstracted their thoughts from religious enquiries; and one boat-load followed another throughout the summer. A Frenchman from Canada, named Makko, who had newly settled in the south, and who sustained the double character of trader and Catholic priest, was particularly successful in

enticing the Esquimaux by the most tempting offers. Besides the evil consequences resulting from these expeditions in a spiritual point of view, so large a proportion of their wares was thus conveyed to the south that the annual vessel which brought out provisions and other necessaries for the brethren, and articles of barter for the natives, could make up but a small cargo in return, though the brethren, unwilling as they were to supply this ferocious race with instruments which might facilitate the execution of their revengeful projects, furnished them with the firearms, which they could otherwise, and on any terms, have procured from the south."

Crantz then mentions a feature of Eskimo life, which however repugnant to the feelings of the Moravians, is of interest to the ethnologist, and has not, so far as we are aware, been observed among the Eskimo of late years. This is the erection of a temporary winter éstufá or public game-house. "A *kache*, or pleasure-house, which, to the grief of the missionaries, was erected in 1777, by the savages near Nain, and resorted to by visitors from Okkak, has been described by the brethren. It was built entirely of snow, sixteen feet high and seventy feet square. The entrance was by a round porch, which communicated with the main body of the house by a long avenue terminated at the farther end by a heart-shaped aperture, about eighteen inches broad and two feet in height. For greater solidity the wall near the entrance was congealed into ice by water poured upon it. Near the entry was a pillar of ice supporting the lamp, and additional light was let in through a transparent plate of ice in the side of the building. A string hung from the middle of the roof, by which a small bone was suspended, with four holes driven through it. Round this all the women were collected, behind whom stood the men and boys, each having a long stick shod with iron. The string was now set a-swinging, and the men, all together, thrust their sticks over the heads of their wives at the bone, till one of them succeeded in striking a hole. A loud acclamation ensued; the men sat down on a snow seat, and the victor, after going two or three times round the house singing, was kissed by all the men and boys; he then suddenly made his exit through the avenue, and, on his return, the game was renewed."

The narrative then goes on to state that "one of the objects of the establishment at Hopedale had been to promote an inter-

course with the red Indians who lived in the interior, and sometimes approached in small parties to the coast. A mutual reserve subsisted between them and the Esquimaux, and the latter fled in the greatest trepidation when they discovered any traces of them in their neighborhood. In 1790, however, much of this coldness was removed, when several families of these Indians came to Kippokak, an European factory about twenty miles distant from Hopedale. In April, 1799, the missionaries conversed with two of them, a father and son, who came to Hopedale to buy tobacco. It appeared that they were attached to the service of some Canadians in the southern settlements, as well as many others of their tribe, and had been baptized by the French priests. They evidently regarded the Esquimaux with alarm, though they endeavored to conceal their suspicions, excusing themselves from lodging in their tent on account of their uncleanly habits. At parting they assured the brethren that they would receive frequent visits from their countrymen, but this has not as yet been the case."

From Cartwright's "Journal of a Residence in Labrador" we glean the following statements, which certainly confirm those of the Moravians: In 1765 a blockhouse was erected in a small fort at Chateau bay to protect the English merchants from the Eskimo. (Cartwright also gives the best account we have seen of the Bethuks of Newfoundland.) The southern tribe of Eskimo were at Chateau bay in 1770, Cartwright observing that some Moravians were there at the same time. He also states that there was an Eskimo settlement "some distance to the northward" of Cape Charles, and that a family of nine Eskimo came to spend the winter living near Cartwright's house, and more Eskimo came to join them in July, 1771, there being thirty-two in all; they traded whalebone with the Eskimo to the northward. Cartwright saw deserted Eskimo winter houses near Denbigh island.

In 1771 he saw an Eskimo pursuing a "penguin" in his kayak near Fogo island, off the coast of Newfoundland!

August 30, 1772, "500 or thereabouts" Eskimo arrived at Charles' harbor from Chateau bay to the southward, to meet their relations from London, whom Cartwright had the year previous taken with him to London, some of them having died in England of the small-pox. In April and May, 1776, Eskimo were observed living near Huntington island. Many Eskimo died in Ivuktoke inlet, probably from the small-pox, brought over from

England. Cartwright also reports seeing Eskimo at Huntington island in 1783, also at Chateau bay, where they were observed in 1786.

The foregoing extracts abundantly prove that the Eskimo repeatedly crossed to Newfoundland, residing, during the summer at least, on the outer islands opposite Belle Isle. No reference is made to the former presence of the Eskimo in Newfoundland. It is not improbable that there was at least a slight intercourse between the Bethuks, the aborigines of Newfoundland, said to be a branch of the Algonkins, and found to be in possession of the island by Cabot in 1497. A stone vessel dug up with other Bethuk remains, is "an oblong vessel of soft magnesian stone, hollowed to the depth of two inches, the lower edges forming a square of three and a half inches in the sides. In one corner is a hollow groove, which apparently served as a spout."[1] If this is, as has been suggested to us by Professor Tylor, attributable to the influence of Eskimo art, the style may have been suggested by the possible intercourse of these aborigines with the wandering Eskimo.

In connection with the subject of the relations between the Indians of Newfoundland and the Labrador Eskimo, may be cited the following statement of that industrious historian, the late Jesuit, Father Vetromile. In an article entitled "Acadia and its Aborigines,"[2] he says: "The Etchimins, Micmacs and Abenakis are very often considered as one nation, not only on account of the similarity of their language, customs, suavity of manners and attachment to the French, but also for their league in defending themselves against the English. Although the Micmacs are generally somewhat smaller in size than the other Indians of Acadia and New France, yet they are equally brave. They have made a long war against the Esquimaux (eaters of raw flesh), whom they have followed and attacked in their caverns and rocks of Labrador. Newfoundland must have several times been the field of hard wars between the Micmacs and Esquimaux; the latter were always chased by the former" (p. 339).

Whether these statements are well grounded, we cannot say,

[1] Newfoundland, its history, its present condition, and its prospects in the future. By Joseph Hatton and the Rev. M. Harvey, Boston, 1883, p. 169. See also Mr. Lloyd's paper, Journal of the Anthropological Institute of Great Britain and Ireland.

[2] Collections of the Maine Hist. Soc., VII, pp. 339–349. 1876. Communicated Jan. 16, 1862.

and have been unable thus far to obtain the sources from which the author drew his conclusions that there were contests between the Eskimo and Indians on Newfoundland soil. Nearly all the extracts we have made tends to show that the Eskimo were generally driven northward by the Indians and confined by them to their natural habitat, the treeless regions of Arctic America, whither the Indians themselves did not care to penetrate.

In 1811 two Moravian missionaries[1] explored the northern coast of Labrador from Okkak to Ungava bay, making an excellent map of this part of the coast. The expedition arose from their desire to establish missions where the Eskimo were abundant, as farther down the coast they were regarded as "mere stragglers."

An Eskimo tradition of interest is mentioned in this book, as follows: "July 24th. Amitok lies N. W. from Kummaktorvik, is of an oblong shape, and stretches out pretty far towards the sea. The hills are of moderate height, the land is in many places flat, but in general destitute of grass. On the other side are some ruins of Greenland [Eskimo] houses.

"The Esquimaux have a tradition that the Greenlanders [*i. e.*, Greenland Eskimo] came originally from Canada, and settled on the outermost islands of this coast, but never penetrated into the country before they were driven eastward to Greenland. This report gains some credit from the state in which the above-mentioned ruins are found. They consist in remains of walls and a grave, with a low stone enclosure round the tomb, covered with a slab of the same material. They have been discovered on islands near Nain, and though sparingly, all along the whole eastern coast, but we saw none in Ungava bay."

(*To be continued.*)

[1] Journal of a voyage from Okkak, on the coast of Labrador, to Ungava bay, westward of Cape Chudleigh, undertaken to explore the coast and visit the Esquimaux in that unknown region. By Benj. Kohlmeister and George Knoch, missionaries of the Church of the Unitas Fratrum. London, 1814, 8vo, pp. 83.

EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— Naturalists will be the gainers by the present discussion of the question as to the existence of objects of more or less than three dimensions. We are accustomed to regard mathematics as exact, and in its true function as the science of *relations* it is so. But we have not always remembered that it may treat of the relations of imaginary quantities as readily as those of real ones. Hence it need not surprise us if the mathematical mind sometimes concerns itself but little with the question of the reality of the subjects of its discussions. This is the explanation of the extraordinary mental phenomenon displayed at the present time in the attempt, by some men of much acuteness, to persuade themselves and others of the existence of objects of two and four dimensions. The argument rests on the *very transparent* assumption that because we usually see only the surface of things, *i. e.*, two dimensions, such surface has an existence apart from the three-dimensional body of which it is an aspect. The deduction then follows that if from the perception of two dimensions we can rise by mental process to a perception of three dimensions, why is it not possible that some minds can rise from the third dimension to a perception of a fourth. The naturalist, however, will expect a third dimension before he will permit himself to believe that he has an object, and any one who would do otherwise would soon find himself in the limbo of the damnati. We invite our two and four-dimensional friends to give us a systema naturæ. Let them have their Linnæus, Cuvier and Darwin. We fear, however, that two-dimensional objects placed edgwise to the line of vision would be overlooked by these gentlemen, while for four-dimensional beings a new teratology would have to be written.

—— Professor John Collett has been removed from the position of State geologist of Indiana, and Professor J. Maurice Thompson has been appointed in his place by the legislature of Indiana. This change is from purely political motives, as nothing was alleged against Professor Collett unfavorable to his administration. We regret this change without knowing aught against the new appointee, as we regret all changes in scientific official relations without due cause. And when the incumbent is an accomplished geologist who has done much good work, and

the new officer is entirely unknown in science, the cause for regret is the greater.

— The bestiarians are getting into trouble through their misrepresentations and libels. We learn from the *Journal of Science* that one Ernst Weber, in Germany, has been imprisoned for six months for making false assertions respecting the physiological investigations of Dr. Pelz. Professor H. N. Martin, of Johns Hopkins University of Baltimore, publishes a vigorous contradiction of the assertions of some British bestiarians, and protests against their statements as libelous. In Philadelphia Dr. Wister, addressing the Women's Society for the suppression of Physiology, calls vivisection "a crime." On the other hand Dr. W. W. Keen made vivisection the subject of his valedictory before the graduating class of the Women's Medical College. He demonstrated the importance of this branch of physiological research.

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RECENT LITERATURE.

RECENT PALÆONTOLOGICAL REPORTS OF THE SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA.—It is now four years since the appearance of Mr. Lesquereux's two splendid volumes on the coal flora of Pennsylvania and the United States, with an atlas of eighty-seven plates. During the last year the third and last part of this great undertaking has appeared. Besides additions and corrections of the first and second volumes, there is a table of species referred to localities; a table of species referred to formations and a revised index of generic and specific names, referred both to pages and to plates, for all three volumes. The bulk of the third part is, however, devoted to descriptions of the new species obtained not only from Pennsylvania but from Arkansas, Rhode Island and other parts of the country. The number of new forms, many of them beautifully preserved and of great interest, fill twenty-six plates. Mr. Lesquereux remarks: "Like the vegetation of the present epoch, that of the Carboniferous has been modified and diversified by local circumstances, and is therefore differently represented at different localities if separated by a considerable distance. This can easily be seen in comparing the coal flora of Pennsylvania and Ohio with that of Illinois, Missouri, Kansas, etc. A certain degree of relation only is recognizable between the plants of strata of the same stage; but a large number of species are only locally found. The differences in the vegetation are still more marked according to stratigraphical distribution of the measures, or between the plants found in strata of different horizons; and as new coal-fields have been

recently opened and coal beds worked in Virginia, Tennessee, Alabama, Georgia, etc., at a lower stage than that of the Northern basins, a mass of specimens of fossil plants, not yet known in this country, have been discovered and sent from those localities." Mr. Lesquereux adds he has had to leave a large amount of specimens still unexamined, and he foresees "that there is left unknown, for future research and study of the history of the vegetation of the coal, an amount of materials at least as great and as important as that which has already been published."

Mr. Lesquereux acknowledges in a note the aid he has received in the loan of specimens from Mr. R. D. Lacoe, of Pittston, Pa., "who has directed for years explorations, still continued, in the more interesting localities of the coal-fields of North America. He has thus brought up, at great expense, a collection of fossil plants of divers formations, of insects, crustaceans, etc., which is not only by far the largest and most valuable of any in America, but which certainly may compare in this specialty with the richest collections of any of the European museums."

The other report is marked P.P.P., 1884, and contains two palæontological papers, valuable in themselves and for their illustrations. The first one, by Mr. C. E. Beecher on the Ceratiocaridæ of the Upper Devonian measures, we have already noticed in this journal; the second is a note by Professor James Hall on the Eurypteridæ from the lower coal measures, and it is illustrated by six heliotypes, an excellent way of illustrating these fossils. One new species (*Eurypterus potens*) is described, and the remains of other species fully illustrated.

THE ZOÖLOGICAL RECORD FOR 1883.[1]—That the work in systematic zoölogy throughout the scientific world went on in 1883 much as in former years, is proved by the fact that the size of each of these useful records remains about the same from year to year. The present volume, which contains no references to the Arachnida, is only twenty-eight pages shorter than its predecessor, in which that class occupied thirty-three pages.

The year 1883 was, so far as regards the mammals, chiefly marked by the large number of palæontological books and papers which appeared, among which those of Ameghino, Cope, Filhol, and Lydekker are the most prominent.

While there are no striking novelties in ornithological work, the year is reported to have been remarkable for a large amount of steady work. Little appears to have been done with the reptiles and Amphibia; beyond special papers no works on ichthology of general importance appeared this year.

As usual over half the volume is devoted to the Crustacea and especially the insects. Regarding the former several monographs

[1] *The Zoölogical Record for 1883;* being volume twentieth of the record of zoölogical literature. Edited by E. C. RYE. London, 1884, 8vo.

and lengthy faunal lists, especially works on deep-sea forms have appeared, as well as important anatomical papers. Important papers on the myriopods appeared in 1883, and of entomological literature there appeared important anatomical and morphological as well as palæontological works and papers, besides some faunal works of value. We shall in another place draw attention to recent discoveries which have not been quoted in our entomological notes. It is enough to take one's breath away to be told that the number of new genera described in 1883 was 1079, while the Arachnida have yet to be heard from.

As we have said in former years the Zoölogical Record is of immediate and pressing value to American students, and it is surprising that more copies are not taken by our working naturalists.

MILLSPAUGH'S AMERICAN MEDICINAL PLANTS.[1]—This is a promising work now issuing in parts, each containing six colored lithographic plates, and from ten to fifteen pages of descriptive text. Upon each plate are shown the characteristic portions of some plant with dissections of the floral organs, or the fruits and seeds. The drawings are generally accurate and the coloring is good. Of course one need not look in a work like this for that degree of accuracy and finish which we are accustomed to see in the drawings by Isaac Sprague, but still they answer their purpose admirably, of enabling the student to identify the different medicinal plants of his flora.

Five parts (composing Fascicle I) of this publication have already appeared, including thirty plates. The whole work will contain 180 plates, and it is the intention of the publishers to complete it within two years. The low price at which it is offered (five dollars per fascicle) places it within reach of everyone who is interested in the medicinal plants of the country. It will also be found an interesting and valuable addition to the library of the botanist.—*Charles E. Bessey.*

PHILOSOPHIC ZOÖLOGY BEFORE DARWIN.[2]—"The evolution of ideas," says the author in his preface, is much like that of "living beings." They ordinarily arise in an humble way, and lie concealed among older ideas, become confounded with them, but slowly they become differentiated, attain a certain strength, transform and die, after having engendered other ideas of a similar kind." The book is an extremely interesting and suggestive one as will be seen by the following titles of the chapters: first ideas on the place of animals in nature; Aristotle; the Roman period;

[1] *American Medicinal Plants;* an illustrated and descriptive guide to the American plants used as homœopathic remedies; their history, preparation, chemistry and physiological effects. By CHARLES F. MILLSPAUGH, M.D. Illustrated by the author. Boericke & Tafel, New York and Philadelphia.

[2] *La Philosophie Zoölogique avant Darwin.* Par EDMOND PERRIER. Bibliothèque scientifique internationale. XLV. Paris, 1884. 8vo, pp. 292.

the middle ages and the renaissance; evolution of the idea of species; the philosophers of the eighteenth century: Buffon, Lamarck, Geoffrey St. Hilaire, Cuvier. Discussion between Cuvier and Geoffrey Saint Hilaire, Goethe, Dugès, the natur-philosophers, the theory of organic types and its consequences; Agassiz; the lower animals; the cellular theory and the constitution of the individual embryology, the species and its modifications.

CANADIAN GEOLOGICAL SURVEY.—The Canadian Geological Survey has published a descriptive sketch of the physical geography and geology of Canada, which has been prepared to accompany a new geological map of the Dominion on a scale of forty miles to one inch. The description of the eastern section is by the Director of the Survey, Dr. Selwyn, and of the western part by Dr. G. M. Dawson. The maps are a valuable addition to geological science, as embodying the latest explorations of the survey, particularly on the Pacific coast, as also in Newfoundland.

TWELFTH ANNUAL REPORT OF THE GEOLOGICAL AND NATURAL HISTORY SURVEY OF MINNESOTA.—The report is mainly devoted to Mr. Herrick's final report on the Crustacea of Minnesota, which has been already noticed in this magazine, and also to Mr. Warren Upham's catalogue of the flora of Minnesota.

RECENT BOOKS AND PAMPHLETS.

Martin, H. N.—A correction of certain statements published in the "Zoöphilist," also a castigation and an appeal. Baltimore, 1885. From the author.

Jackson, A. W.—On the morphology of Colemanite. Bull. Cal. Acad. of Sciences, Jan., 1885. From the author.

Derby, O. A.—Physical geography and geology of Brazil. Rio Janeiro, 1884.

——On the flexibility of Itacolumite. Ext. Amer. Jour. of Science, 1884. Both from the author.

Rice, W. N.—The geology of Bermuda. From Bull. No. 25 U. S. National Museum. Washington, 1884. From the author.

Sharp, B.—Homologies of the vertebrate crystalline lens. Ext. Proc. Nat. Sci., Phil., 1884. From the author.

Frazer, P.—Address read before the Royal Society of Canada, May, 1884. From the author.

James, J. F.—The Fucoids of the Cincinnati group. Ext. Jour. Cin. Soc. Nat. Hist., 1884. From the author.

Kollmann, J.—Hohes Alter der Menschenrassen. Zeitschrift für Ethnologie, Berlin, 1884. From the author.

Ryder, J. A., and Puysegur, M.—Papers on the development and greening of the oyster. Washington, 1884. From the authors.

Geinitz, H. B.—Ueber die Grenzen der Zechsteinformation und der Dyas uberhaupt. From the author.

Crosby, W. O.—Origin and relations of continents and ocean basins. Ext. Proc. Bost. Soc. Nat. Hist.

——On the relations of conglomerate and slate in the Boston basin. Ext. idem.

——On the chasm called "Purgatory" in Sutton, Mass. Ext. idem. All from the author.

Oliver, C. A.—A correlation theory of color perception. Ext. Amer. Jour. Med. Sci., 1885. From the author.

Gardner, J. S.—The age of the basalts of the Northeast Atlantic. Read before the Belfast Nat. Field Club, 1884.

—British Cretaceous Nuculidæ. Ext. Quart. Jour. Geol. Soc., 1884.

—Relative ages of American and English fossil floras. Ext. Geol. Mag., 1884. All from the author.

Robinson, J.—Report of the committee on forest trees. Ext. Proc. Essex Agric. Soc., 1884.

—Botany in Essex county. Ext. Bull. Essex Institute, 1884. Both from the author.

Beecher, C. E.—Some abnormal and pathologic forms of fresh-water shells from the vicinity of Albany, N. Y. Ext. 36th Rep. N. Y. State Mus. Nat. Hist., 1884. From the author.

Willard, S. W.—Migration and distribution of North American birds in Brown and Ontagamie counties. From the author.

Struthers, J.—On the bones, articulations and muscles of the rudimentary hind-limb of the Greenland right whale. Ext. Jour. Anat. and Phys., Vol. XV, 1881. From the author.

Stevenson, W. G.—Does spiritualism transcend natural law? From the author.

Baur, G.—On the centrale carpi of the mammals. Ext. Amer. Nat., Feb., 1885. From the author.

Scott, W. L.—The great white egret and the yellow rail in Ottawa, Canada. From the Auk, 1885.

—The winter Passeres and Picariæ of Ottawa. Both from the author.

Hanks, H. G.—Fourth annual report of the State mineralogist of California, 1884. From the author.

Graff, L. von—Ueber einige Deformitäten fossilen Crinoiden. From "Palæontographica," 1885. From the author.

Dames, W.—Ueber Archæopteryx. Palæontologische Abhandlungen, Band II, Heft 3. From the author.

Deslongchamps, E.—Etudes Critiques sur des Brachipodes nouveaux on peu connus. 1884. From the author.

Collett, J., Cope, E. D., and Wortman, J.—Fourteenth annual report of the State geologist of Indiana. Part I. Geology and natural history. Part II. Post-pliocene Vertebrates of Indiana. From the State geologist.

Topinard, P. — Eléments d'Anthropologie Générale. Paris, 1885. From the author.

Scudder, S. H.—The earliest winged insects of America. Cambridge, Mass., 1885. From the author.

Lydekker, R.—The Labyrinthodont from the Bijori group. Memoirs Geol. Surv. of India. From the author.

Kingsley, J. S., et al.—The Standard Natural History. Vol. I. Lower Invertebrates. Cassino & Co., Boston, 1885. From the publishers.

Winchell, N. H., and Harrington, M. W.—The geological and natural history survey of Minnesota. Vols. IV, VII, X, XI, XII. From the authors.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AFRICA.—*The Niger.*—General Faidherbe, in an article upon the "Niger Question," in the *Revue Scientifique*, tells us that the people of the marshy delta, and of the fine country beyond as far as Idda, are fetishists, while from this point Mussulmans dominate.

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

Lokodja is governed by a prince named by the king of Nupé, himself a satrap of the Sultan of Sokotto. Rabba the capital of Nupé, has 70,000 inhabitants. Above Egga the river becomes shallow, and vessels drawing more than four or five feet cannot proceed to Rabba. The constant falling in of the western bank renders navigation of the Lower Nile difficult. French commercial companies no longer exist on the Lower Niger. The Upper Niger is dominated by three powerful chiefs. The "prophet" Samory, a sort of religiously fanatic slave-hunter, who burns his unmerchantable prisoners, occupies the upper portion. Below him is Amradon, chief of a better organized state, with an army of Tonconleur cavalry and Bambarra infantry, and lastly, between Sansandig and Timbuctoo, comes Tidiani, who, with his bands of brigands, cuts off the communications of the latter once flourishing city.

Timbuctoo has for over 200 years been ruled by a "kahia," a kind of burgomaster originally appointed by the Emperor of Morocco from the Moorish Andalusian family of Er-Rami. The office became hereditary, but the present kahia or Amir Muhammed Er-Rami, who is now in Paris, has little power, and is practically a puppet in the hands of whichever of the rival Arab, Berber or Fulah factions have the upper hand. The Arab chief, Sheikh Abadin, sides with the Fulahs or Fulani, whose power is continually increasing, and who are likely to become absolute masters of Timbuctoo unless it falls into the hands of some European power.

Harrar.—The province of Harrar proper lies in a circle around the city of that name, and has a population, according to Major F. M. Hunter, of nearly 329,000. The city of Harrar is fortified so as to be fairly defensible against native attack, and contains an area of 200 acres, and a population of about 30,000, two-thirds of whom are women, and only about one-third natives of the city. The suburbs contain 6000 more. Harrar is regarded by Professor Keane as an outlier of Abyssinian civilization, and perhaps is a remnant of the ancient kingdom of Adela or Ada, once a powerful enemy of Abyssinia. At any rate it has for centuries preserved within its walls a distinct race, speaking a tongue not understood by its neighbors, and has been the center of trade for the surrounding countries, dispatching caravans to Tajura, Zeila, and Berbera. The city has some 4500 domiciles. Major Hunter gives some details of the material condition, dress, domestic ceremonies, etc., of the women, and refers to the account given by Burton in "First Footsteps in East Africa." Debased Egyptian piastres and Maria Theresa dollars are the only currency, and the only industries are bookbinding and weaving. The principal indigenous exports are coffee, and wars or safflower. Harrar is 286 miles from Berbera, and 182½ from Zeila.

ASIA.—*Asiatic Notes, Etc.*—Four French officers, who have journeyed among the Muongs of the Black river of Tonquin, de-

scribe them as more civilized than the Mois of Cochin China. Thev are warlike, intelligent and industrious, and make their own arms. Practically, they are independent, though the Annamites profess to appoint their chiefs. The country is rich in minerals, and some gold fields are worked by Chinese, who permit no stranger to approach.——The commission to investigate the possibility of a canal across the Isthmus of Krao, Malacca, has explored a part of the peninsula before unknown to Europeans. They were conducted to a large inland sea, called Tale-Sab (the name seems identical with Tonle'-Sap, in Cambodia). This lake is forty-five miles long and twelve wide, and has numerous small islands covered with the nests of sparrows. The state of Sam-Sam, composed of mestizos, or half-caste Malays and Siamese, a population somewhat inclined to piracy, exists at about 7° 14′ N. lat. ——Mr. Mueller's reconnaissance survey between Cascade plateau and Lake McKerrow, on the west coast of the middle island, New Zealand, has shown that a great part of the Hope range is auriferous, while traces of gold occur along the whole length of Gorge river. The most remarkable geological feature is the Olivine range, a red-violet mass devoid of almost every trace of vegetation from about 1000 feet above the Cascade river.

EUROPE.—*European Notes.*—The Norwegians have discovered several new islands to the east of King Karl or Wiche land. In 1884 the west side of Spitzbergen was blocked by a belt of land-ice, the whole summer through, while the east side, which is usually blocked, was more open than for many years. The prevailing direction of the winds appear to cause these changes. Observations prove that the level of the shores of the Baltic is changing with considerable rapidity, the northern shore rising, while the southern is sinking. The northern part of Sweden has risen seven feet in the last 134 years, but the rise diminishes southward until at the Naze it is only one foot, and at the island of Bornholm nothing. The line of equilibrium passes along the islands of Bornhohm and Gothland.——The Brussels National Institute of Geography is now publishing a *fac-simile* reproduction of the plans of a hundred Belgian towns drawn up between 1550 and 1565, by J. de Deventer, at the command of Charles V and Philip II, of Spain. The originals are divided between the libraries at Brussels and Madrid.

AMERICA.—*Physical Aspect of Brazil.*—The greater part of Brazil is an elevated plateau, having a main elevation of from one to more than three thousand feet. This great plateau is bounded northward by the great Amazonian depression, westward by the basin of the Paraguay, which is continued northward by that of the Guaporé, a tributary of the Madeira, and all along the ocean border by a narrow strip of coast. North of the great Amazonian valley rises a second smaller pleateau, continuous with that of

Guiana. The sketch map of Brazil, prepared by O. A. Derby for Vol. 1 of La Geographica physica do Brazil is a revelation to those whose knowledge of Brazil is mainly confined to the Amazons. Not one-tenth of the entire country, according to this map, is less than 300 meters above the sea, and the region above 1000 meters is at least half as large as those below 300. The true mountains of upheaved strata are mainly in the eastern and central portions of the Brazilian plateau, and may be considered as forming two groups, separated by the elevated table lands of the Parana and Sao Francisco basins. The culminating points of the eastern group are the peaks of the Organ mountains in the Serra do Mar, and Itatiaia (2712 meters), the highest point in the empire. The western group consists of at least two distinct ranges, culminating in the Montes Pyreneos near Goyaz. The great table-lands, though composed of horizontal strata, are often so excavated by the deep river valleys as to have the appearance of mountains. On their eastern border, in the provinces of Parana and São Paolo, they rise to 1000 meters. The water-parting between the rivers flowing south and those flowing north is partly formed by a transverse ridge across the southern part of Minas Geraes, connecting the two groups of mountains. The Tocantins, Xingu, Tapajos, and Madeira, all descend from the tableland in a series of rapids at from 100 to 200 miles from the Amazon. The Brazilian portion of the Guiana plateau is very imperfectly known, but some spurs of its highlands extend to within a few miles of the Amazons between the mouth of the Rio Negro and the ocean.

American Notes.—The Ona of Terra del Fuego are estimated by Lieut. Bove at from 300 to 400, and the total number of Fuegians, men, women and children in the archipelago, according to a careful census made by the English missionary, the Rev. T. Bridges, is given as 949.——Mr. E. M. Thurm telegraphed to Kew that he has succeeded in ascending Roraima.——Capt. Eduardo O'Connor has navigated the Rio Negro of Patagonia from its mouth in the Atlantic to its source in the romantic Lake Nahuel-Hualpi in the Chilian Andes. He was able to proceed by steamer as far as the confluence of the Colhincura' or Catapuliche, but beyond that point was compelled to make his way in an open boat. The Upper Limay, the furthest southern headstream of the Rio Negro, flows over numerous rapids in a narrow rocky bed, contracting at some points to 120 or even 100 feet. In 40° 42′ S. lat., beyond the confluence of the Treful, the rapids disappear, the stream is deeper and less swift, and navigable for steam launches to the lake. The scenery of the alpine basin of the lake is represented as charming. The country around appears to be uninhabited.——The Indians who inhabit that part of the Chaco, to which the Argentine government has sent an expedition, are supposed to number about 10,000. Their weapon is the arrow,

and, when hunting and fishing fail, they live on locusts and on stolen cattle. It is hoped that the Rio Bermejo will be found to be navigable after its junction with the Tenco.——Dr. Claus left Cuyaba, in Matteo Grosso, in May, 1882, navigated a small river to its junction with the Xingu, and followed the latter to its mouth.

Lake Mistassini.—A letter to *Science*, from A. R. C. Selwyn, Director of the Geological Survey of Canada, states his belief that Lake Mistassini consists of several almost separate lakes, but that the entire body of water is not to be compared with that of Lake Superior. The exploration of the region was commenced in 1870–71, and last spring a party was despatched to continue the work. The sensational article in the *Montreal Witness* arose out of an interview of a reporter with Mr. F. H. Bignell, who had just returned from taking winter supplies to the exploring party. The communication of Mr. Selwyn is accompanied by a tracing of Eugene Tache's map of the province of Quebec, the only map upon which the results of the surveys of 1870–71 are correctly laid down. Geologically the lake lies in a basin of flat lying limestones, probably of Lower Cambrian age, resting on Laurentian and Huronian rocks.

Dr. Carver. A Correction.—In your March number, p. 231, an error crops out in "Carver the celebrated *English* traveler."

According to the North American Cyclopedia, "he was an American traveler, born at Stillwater, Connecticut, in 1732."

The notice proceeds with an incorrect statement, viz., "He crossed the continent to the *Pacific*, and returned to Boston in 1768, having traveled about 7000 miles."

Whereas, with a plan to go to the Pacific, he left Boston in June, 1766, went by the lakes, Green bay and Fox river portage to and up the Mississippi and the sources of St. Peter's river, where he wintered. He returned in the early summer of 1767 to Prairie du Chien, and in June, went, via the Mississippi and Chippewa rivers, &c., &c., to the north side of Lake Superior, coasted down to Sault St. Marie, then to Michillimackinac, where he spent the winter. "The next season he arrived in October, 1768, at Boston, after an absence of two years and five months, and a journey of near 7000 miles," p. 111.

See his Travels, Philadelphia, 1796, for which there were about 1600 subscribers whose names are given.

Two editions (p. 1) seemed to have appeared under his care, and the one in Philadelphia was a third.—*O. P. Hubbard, 65 W. 19th street, New York.*

GEOLOGY AND PALÆONTOLOGY.

THE MAMMALIAN GENUS HEMIGANUS.—This genus was characterized by me in the NATURALIST for 1882, p. 831,[1] from a number of teeth. The typical species, *H. vultuosus* was supposed to be a beast of about the size of a tapir. Its exact position was not determined. Jaws with teeth and a part of the skeleton of a second and smaller species of the genus recently received, throw much light on its characters, and demonstrate that it is one of the most remarkable of the Eocene Mammalia yet discovered.

The claws are large and compressed like those of a prehensile-footed carnivore. The astragalo-tibal articulation is nearly flat. The femur is very robust, and has a low third trochanter, as in Bunotheria generally. The vertebræ of the neck are short and wide. The jaws have a very large and wide coronoid process, as in Calamodon, and the horizontal rami are very robust. The molar teeth of the lower jaw have but one root. Only one true molar (the first) is preserved, and it has the crown worn. Its outline is sub-round, with a notch on the internal side. There are probably four premolars, and their crowns are short, obtuse cones, with a low heel-like expansion at the inner side of the posterior base. They resemble very nearly the teeth of some of the eared seals. There is a robust canine tooth in the upper jaw, which is not separated from the premolars by a diastema. There is at least one superior incisor, but the exact number is unknown. There is a large tooth on each side of the symphysis of the lower jaw, but in the specimens it is not in place. It has enamel on the anterior face only, and its apex is worn transversely. The wear descending passes to one side of the middle line. It evidently has a median position, and may therefore be an incisor. Its form reminds one of that of the second inferior incisor of Calamodon, but the enamel-face is much shorter.

Should the large inferior teeth be canines, the mandibular dentition will greatly resemble that of the seals, as does that of the maxillary bone. The absence of postorbital angles resembles the condition in the Phocidæ. The wide vertical coronoid process and the flat vertical angle are as in Calamodon. The sagittal crest is elevated, and the brain-case very small.

Hemiganus may for the present be referred to the Creodonta where it will stand quite alone, and next to the Tæniodonta.

The species which is represented by the specimens referred to; may be called *Hemiganus otariidens*. It may be characterized as follows: Enamel of teeth everywhere smooth. Posterior true molars smaller than the anterior. Diameter of crown of M. 1: transverse .008; anteroposterior .008. Diameter of large inferior ? incisor at shoulder: anteroposterior .017; transverse .008. Depth of ramus at P-m. III .040; at coronoid process .090; length

[1] It is figured on Plate XXIII *c*, figs. 7–12, Report U. S. Geol. Survey Terrs., III.

of ramus posterior to P-m. III inclusive .106. From the lowest beds of the Puerco epoch. D. Baldwin.—*E. D. Cope.*

MARSUPIALS FROM THE LOWER EOCENE OF NEW MEXICO.—Two families undoubtedly referable to the Marsupialia have been identified from the Puerco Eocene, the Polymastodontidæ and Plagiaulacidæ (see NATURALIST, 1884, p. 686, for an account of these animals). One genus of each is known, viz., Polymastodon and Ptilodus. I now add a third genus in the Neoplagiaulax of Lemoine, which belongs to the Plagiaulacidæ, and has been represented hitherto by a single species from the Puerco beds of Rheims, France. The American species is very distinct from the European, and comes from the base of the formation in New Mexico. I describe it as follows:

Neoplagiaulax americanus.—Size a little exceeding that of the *Ptilodus mediævus*, and many times larger than the *N. eocænus* Lemoine. The large fourth premolar is less elevated than in the two species mentioned. Its cutting edge is obtusely serrate, and the lateral keels though fine, as in *P. mediævus*, are only seven in number instead of twelve. The posterior base wears into a little truncation. The molars are much as in the species named. The tubercles are coarse and number four on each side on the first, and two on each side on the second. The incisor is much compressed, and the enamel band is perfectly smooth. The coronoid process rises opposite the second tubercle of the first true molar. Measurements: Length of base of P-m. IV .012; elevation of crown of do. .006; length of bases of molars .009; of first true molar .006. Depth of ramus at middle of P-m. IV .011; at diastema .008. Depth of incisor at middle .006; width of do. at do. .003. D. Baldwin.

Ptilodus trovessartianus Cope, Report U. S. Geol. Survey Terrs., III, p. 737, Pl. XXV *f*, Fig. 19.—Two mandibles of this species, found by Mr. Baldwin, are in excellent preservation, including both the two premolars and the two true molars, and showing that the species belongs to Ptilodus rather than to Neoplagiaulax. Besides its inferior size, this species differs from the *P. mediævus* in the smaller second true molar. The tubercles of this tooth are two on each side; in the *P. mediævus* they are four on one side and two on the other. It comes from the middle horizon of the Puerco.

Polymastodon taoënsis Cope: *Tæniolabis scalper* Cope, Report U. S. Geol. Surv. Terrs., III, p. 193, Pl. XXIII *d*, Fig. 7.—The genus Polymastodon is found in the lowest horizon of the Puerco in abundance, but is rare, if present, elsewhere in the formation. Specimens of the species above mentioned include incisors of the kind which furnished the typical description of the *Tæniolabis scalper*, with superior molars of this genus, and probably of the species *P. taoënsis*, of which several undoubted specimens were

found by Mr. Baldwin at the same locality. *T. scalper* was probably founded on superior incisors of *P. taoënsis.*

Polymastodon attenuatus, sp. nov.—This form is represented by a mandibular ramus with entire dentition, of one individual, and by a superior incisor with portions of inferior molars of a second. The specific character is seen in the very compressed incisors and general lightness of structure of the ramus, in which it is quite different from the species of similar size, the *P. taoënsis* and *P. latimolis* (NATURALIST, April, 1885). The tubercles and proportions of the true molars are as in *P. taoënsis.* The apex of the fourth premolar is transversely fissured. The superior incisor is much more compressed than in that of *P. taoënsis*, and is more rapidly acuminate in its form, to the subacute apex. There are no facets of the internal side as in that species. The enamel covers almost the entire external face, and is marked by rather coarse parallel grooves. A groove runs along the concave edge of the crown, forming the edge of the enamel excepting for its distal half, where the enamel crosses it, and covers the internal side for its distal fourth. The inferior incisor is also much compressed so that the enamel is presented externally rather than anteriorly, and its cutting edge is nearly anteroposterior and not transverse, as in *P. taoënsis.* Its surface is obsoletely grooved. Length of superior incisor .25; diameters do. at middle: anteroposterior .013; transverse .006. Length of inferior true molars .032; depth of ramus at middle M. 1. .034.—*E. D. Cope.*

THE LOUP FORK MIOCENE IN MEXICO.—A considerable extent of tertiary deposit in the State of Hidalgo and the adjoining parts of Vera Cruz has been announced by Professor Antonio de Castillo in the report of the School of Mines of Mexico for 1883. I recently visited the region, and obtained from the beds bones and teeth belonging to species of Protohippus, Hippotherium and Mastodon, and probably Procamelus; and Professor Castillo has teeth of Dicotyles. It is thus evident that the horizon is the Loup Fork or Upper Miocene of the North American series. This is by far the most southern exhibition of this formation, the nearest locality which I have identified with it being in New Mexico. In its Mexican area it occupies a tract of at least eighteen miles by six, which at present presents an extremely irregular surface. It is excavated into numerous valleys of erosion by tributaries of the Tuxpan and Benados rivers, some of which are fifteen hundred feet in depth and quite narrow. The axes of the high lands consist of trap, which in some instances are dykes, as the limestones of palæozoic or mesozoic age lie against them inclined at high angles. Some of these traps inclose masses of obsidian of various sizes. The entire Loup Fork formation is now not less than two thousand feet in thickness, as it not only fills the valleys but also caps the traps. Several thin beds of coal occur in it, both above and below the escarpments of trap; in the latter case

frequently dipping at a low angle towards the trap. Between the coal beds are shales apparently composed of volcanic ash, and beds of excellent clay. The country is covered with vegetation ranging from that of the *Tierra fria*, with pines, oaks, Liquidambar, Platanus, Alnus, Negundo, etc., to the moderate *Tierra caliente*, with oranges, Zamias, Cereus, etc. The fossils are only found in making artificial excavations.—*E. D. Cope.*

Discovery of an Extinct Elk in the Quaternary of New Jersey.—Professor William B. Scott, of Princeton, made (reports *Science*) a communication on an extinct elk, a skeleton of which was recently found in the quaternary of New Jersey. The bones, which are in a state of remarkable preservation, were dug from a bog near Mount Hermon. They were at first supposed to belong to a moose, but, on further examination, it was seen that the skeleton was that of a remarkable form of deer-like animal, between the genera Cervus and Alces, and the name Cervalces was therefore proposed for it. Among other peculiarities, the animal was characterized by long legs and short neck, indicating that it was fitted to progress rapidly through the snow, and that it was not a grazing animal, but obtained its food by browsing on trees as does the moose. Its long nasal bones, however, indicated that it was not provided with the long, fleshy lips of the moose, which amounts almost to a probocis, and that it was therefore at a comparative disadvantage in gathering its nourishment from the branches of trees. The antlers of the specimen are still in the velvet, indicating that the individual probably died in September. They are provided with curious scoop-shaped processes at the base, which, when the head was lowered, must have actually obscured lateral vision. The use of these processes, the presence of which to all appearances was simply a disadvantage to the animal, cannot be determined. The form is peculiarly interesting as illustrating at least one link between two markedly divergent genera, and as suggesting their line of descent. The speaker dwelt at length on the adaptations of structure to surroundings, and gave in detail the diagnostic characters of Alces, Cervus and Cervalces. His remarks were illustrated by photographs and diagrams.

Tertiary Man at Thenay.—The most interesting question brought before the geological section of the French Association was the existence of man in the tertiary epoch. In 1867 the Abbé Bourgeois found at Thenay (Loir et Cher) some flints which he believed to be worked by man or split by fire. Extensive excavations were made at Thenay, which is about twenty kilometers from Blois, and forty members of the Association repaired thither to examine the locality. Comparison with the surrounding strata showed that the bed (of greenish clay mixed with small flints) in which the presumably worked flints occurred, was an upper

stratum of the argillaceous flint-bed which everywhere underlies the Beauce limestone, and therefore is early miocene or even eocene. Only two flints were found which bore the apparent impress of human handiwork, but the splitting which has been attributed to fire, was more common. The great majority of the members concluded that, considering the enormous extent of the beds, the rarity of the peculiar flints found and their unknown use, and the possibility that the effects, like those of fire, were produced by some unknown natural cause, there was nothing to warrant a belief in the existence of man at so remote a period.

A map of the environs of Blois constructed for the geological map of France, and presented to the Association, shows that the Beauce limestone was deposited in a lake, while the clay, with flints, passes beneath the limestone and forms the borders of the lake.

GEOLOGICAL NOTES.—*General.*—It appears from Dr. R. D. M. Verbeek's atlas and description of Sumatra, between 0° 14″ and 1° S. lat. and 99° 45′ and 101° 25′ E. long., that productive coal is wanting in the explored district, and that mesozoic beds are also lacking. The Eocene lies upon the Carboniferous, and the newer Tertiary strata appear to be wanting in the same area. The conclusions arrived at concerning the geology of the island, are that at the end of the Eocene or beginning of the Miocene, an eruption of andesite from fissures occurred in Sumatra, Java and Borneo, contemporaneous with the uplifting of the highlands of Padang. In Bencoolen, Lower Miocene beds overlie this andesite, and at the same spot Middle and Upper Miocene and Pliocene strata also occur. The Pliocene marl shows no trace of newer eruptive materials, while the overlying Quaternary consists of clay and andesite material. In Java, also, the Eocene strata are broken through by andesites and basalts, and the probably Miocene strata which overlie the orbitoides limestone contain andesite materials. The great craters are more modern than the fissure-poured andesite, and between them intervened a period of comparative calm. The commencement of the activity of these volcanoes cannot be fixed with certainty, but was probably nearly quite at the end of the Tertiary period.

Carboniferous.—M. Dieulafait has conducted a series of experiments upon recent Equisetaceæ, with a view to ascertain the reason why coal is always impregnated with sulphur, and why coal ashes do not contain free carbonates of the alkalies, such as were general in the ashes of recent plants. He finds that modern Equisetaceæ contain a proportion of sulphuric acid very much in excess of that contained by other recent plants, and arrives at the conclusion that, as the flora of the Coal Measures was largely composed of Equisetaceæ, it is to them that the great quantity of sulphur and sulphate of lime is due. The absence of

alkaline carbonates in the ashes of coal is a natural consequence of the excess of sulphate of lime always present in the ashes.——Johann Kusta describes *Anthracemartus krejcii*, a new Arachnid from the Carboniferous of Bohemia. H. B. Genitz describes Krerscheria, a pseudo-scorpion.

Permian.—An impression of a terrestrial shell (*Dendropupa walchiarum* Fischer) has been found in the Permian beds of Saone et Loire. This is the only terrestrial mollusk of Carboniferous age that has yet been found on the European continent. *Dendropupa vetusta* was described in 1853 by Dawson, from trunks of Sigillaria in Nova Scotia, and several other Devonian and Carboniferous pulmonates have since been found in America.

Tertiary.—Johann Kusta enumerates three species of Hyopotamus and two of Anthracotherium from the Hempstead beds of the Isle of Wight.——W. Davies has verified the occurrence of Hyaenarctos in the Miocene strata of Pikermi near Athens.——W. Davies (*Geol. Mag.*, Oct., 1884) describes *Viverra hastingsiæ* and remains of two other carnivores from the Eocene fresh-water beds of Hordwell, Hampshire.——J. S. Gardiner describes (*Geol. Mag.*, Dec.) six species of Aporrhais, all belonging to an ancestral type of the recent *A. pes-pelecani*, from the Eocene of Great Britain.——R. Lydekker describes a new species of Merycopotamus (*M. nanus*), from examples in the British museum.

Quaternary.—Entire skeletons of the cave hyæna are rare, for these animals devoured the bones of their own as well as of other species. Recently M. F. Regnault, of Toulouse, has descended into a cavity twenty meters deep in the grotto of Gargas, Hautes Pyrenees, and has found entire skeletons of hyænas, bears and wolves, the position being such that the hyænas could not get at the bones to devour them. From examination of these bones, M. Alb. Gaudry believes that *H. spelæa* is but a variety of *H. crocuta.*

MINERALOGY AND PETROGRAPHY.[1]

WADSWORTH'S LITHOLOGICAL STUDIES, PART I.[2]—This handsomely printed quarto volume of over two hundred pages and many colored plates, at first glance promises, both from its title and general scope, to be a most valuable addition to the literature of petrography; nevertheless a careful study of its contents fails to discover as much that is new and useful as was at first expected. The work aims to be an exhaustive and critical revision of all the petrographical work hitherto accomplished as well as an attempt to rearrange the same in accordance with the author's

[1] Edited by Dr. GEO. H. WILLIAMS, of the Johns Hopkins University, Baltimore, Md.

[2] Lithological Studies, Part I. A description and classification of the rocks of the Cordilleras. By M. E. Wadsworth. 4to, with 8 colored plates. Memoirs of the Museum of Comp. Zoölogy at Harvard College, Vol. IX, Oct., 1884.

somewhat peculiar views. The petrographical descriptions are, however, largely taken from the work of others, while those which are original are not sufficiently detailed; the generalizations are often broader than the facts thus far accumulated would seem to warrant; and even the statement of the writer's most original ideas regarding rock nomenclature and classification is not in certain points altogether free from ambiguity.

Chapter first, containing nine sections, deals with the interior structure of the earth; the origin and alterations of rocks and of their constituent minerals; the methods of rock-classification hitherto followed and their defects, and lastly, the proposal of the author's system of classification.

Sedimentary and eruptive rocks are held never to grade into one another, as sometimes appears to be the case. Each class possesses field and microscopic characteristics sufficiently marked to make their separation possible, although by alteration they may come to much resemble each other. All eruptive rocks of the same chemical compposition were alike at the time of their formation; the present differences in structure, etc., are due mainly to the alteration of the older ones. The minerals tend to constantly pass from less stable compounds to those which are more stable for the conditions now existing on the earth. The alteration therefore varies with the age, and also, under the same conditions, inversely as the amount of silica which the rocks contain. Foliation or schistose structure is no necessary proof of the sedimentary origin of a rock. Inasmuch as the alteration of a rock goes on in some cases much more rapidly than in others, lithological character can be regarded as no index of age.

The mineral constituents of an eruptive rock are divided into three classes: 1st, those present in the magma before its extrusion (foreign); 2d, those formed at the time of the consolidation of the magma (indigenous); 3d, alteration products (secondary). The first class is regarded as composed entirely of foreign inclusions, no account being taken, as it seems, of such minerals as leucite, olivine, etc., which may crystallize out of the molten magma long before it is extruded or solidifies! Hornblende appears to be regarded as always belonging to either the first or third class.

The present systems of rock-classification, based on chemical composition, structure, mineral constituents and geological age, are reviewed in turn and pronounced artificial and unsatisfactory. Section VIII contains the statement of thirteen principles which the author thinks should underlie a natural classification of rocks. It must be confessed, however, that this attempt is not altogether satisfactory. It is stated that *all* the petrological (field), lithological (microscopical) and chemical characters of a rock must be used in determining its species, but in what way is not made clear. Mineral composition is sufficient to define varieties but not species. All rocks which may be followed from one form to

another, whatever be the changes of chemical or mineral composition or of structure, *within certain limits*, form a species; but what these limits are is not stated. A diorite derived by paramorphosis from a gabbro must be called a gabbro. Even quartz which might have replaced a basalt would have to be called basalt, strange as this would seem, unless these "certain limits" be defined. Wadsworth's classification seems to be, after all, mainly a chemical one in which the rocks of approximately the same composition, but differing in their constituents, structure or degree of alteration are arranged under the principal species as varieties.

Chapter second commences the systematic treatment of rock classes, starting with the most basic. The suggestion of Reyer, to consider the meteorites as eruptive rocks more basic than any normally found near the earth's surface, is wisely followed. Species I, Siderolite, is made to include all masses of iron, either native or in its secondary state as magnetite, hematite, etc., which are not of chemical or secondary origin. This species is of course principally represented by meteoric iron. Species II, Pallasite, includes such original, eruptive, celestial or terrestrial rocks as contain a large amount of native or oxidized iron inclosing other minerals. Twenty-two meteoric pallasites are mentioned. As a terrestrial variety of pallasite is described the so-called "cumberlandite" from Rhode Island, an apparently eruptive mass of magnetite full of crystals of olivine, feldspar, etc. Analogous to this is Sjören's "magnetite-olivinite" from Taberg, in Sweden.

Chapter third deals with Species III, Peridotite. This name was given by Rosenbusch to massive rocks composed essentially of olivine together with various pyroxenic minerals. The author classifies these as follows:

Variety 1.	*Dunite*	= olivine + picotite.
" 2.	*Saxonite*	= olivine + enstatite.
" 3.	*Lherzolite*	= olivine + enstatite + diallage.
" 4.	*Buchnerite*	= olivine + enstatite + augite.
" 5.	*Eulysite*	= olivine + diallage (= "Wehrlite").
" 6.	*Picrite*	= olivine + augite.

Serpentine is derived by alteration from all of these.

Eulysite is a name that was originally applied to a rock very rich in garnet, and it is difficult to see why it is preferred to the German term wehrlite, used for olivine-diallage rocks. Forty meteoric peridotites are enumerated, following which is a section devoted to the origin and character of meteorites in general. The "chondri" are regarded as spherules due to crystallization, and the meteorites themselves as having probably been thrown off by the sun. Then succeeds the description of many terrestrial peridotites and serpentines, with general remarks on their character and origin. Considerable space is devoted to the relations be-

tween picotite and chromite. Both are translucent with a brown color when sufficiently thin, but the latter only with considerable difficulty. The suggestion is made that the chromite may be an alteration-product of picotite.

Chapter fourth deals with the fourth rock-species, Basalt, of which, however, only such as are of meteoric origin are treated in the present portion of the work. Pages I–XXXIII at the close of the book contain valuable tables of all the chemical analyses hitherto made of the rocks described. Eight plates with forty-eight colored figures represent the microscopic structure of these same rocks in an admirable manner.

MINERALOGICAL NOTES.—*Quartz.* Professor G. vom Rath,[1] of the University of Bonn, has recently made a valuable contribution to the literature of American mineralogy by his studies of the quartz crystals from Alexander county, N. C., material for which was loaned him by Mr. C. Bement, of Philadelphia, and Mr. G. F. Kunz, of Hoboken. The crystallography of these quartzes is very varied and complicated, and the writer does not hesitate to pronounce this American locality the most interesting one thus far known in the world. The tetartohedral character of this mineral is frequently shown by the large development of the trigonal trapezohedron $-\frac{\frac{3}{2}P\frac{3}{2}}{4}$. Complicated twins and many acute rhombohedrons, especially 3R, are also common.—— The same paper contains the description of tridymite from Krakatoa, in which the opinion is expressed that, as Merian has already suggested (vid. NATURALIST, March, 1885, p. 300), the form of this mineral is hexagonal, its optical anomalies being due to molecular disturbance produced by a change of the conditions under which the crystals were formed.——Much new material has been received regarding the mineral colemanite, mentioned in the March NATURALIST, which occurs in the southern part of Death valley, Inyo county, California. An exhaustive monograph on its crystallography, by Professor A. Wendell Jackson,[2] enumerates thirty-eight forms (of which $\frac{68}{11}P\overline{\infty}$, given in the *Am. Jour. Sci.* for Dec. is not one). Of these fourteen were independently observed by vom Rath,[3] and twenty by both Hjortdahl,[4] of Christiania and Arzruni[5] of Breslau. Vom Rath and Bodewig give the plane of the optical axes as perpendicular to $_{\infty}P\breve{\infty}$, making an angle with $\frac{1}{c}$ in the obtuse angle β of 82° 42′, for so-

[1] Mineralogische Notizen. Verhandlungen des Natur. Vereins d. preuss. Rheinland und Westph., 1884. Bonn, 1885.

[2] Bulletin of the California Academy of Sciences, No. 2, Jan., 1885.

[3] Verhandlungen d. Natur. Vereins d. preuss. Rheinland and Westph., p. 333, 1884.

[4] Zeitschrift für Krystallographie, Vol. x, 1885, p. 25.

[5] Verhandlungen d. Natur. Verein d. preuss. Rheinland and Westph., p. 342, 1884.

dium light. The real optical angle, $2V_a$, is 55° 20′. These results agree very closely with those obtained by Hjortdahl.——Hans Thürach[1] has contributed an interesting paper on the wide distribution of zircon and certain titanium minerals as microscopic rock-constituents. Decomposed rocks were especially investigated, from which these minerals were the more easily separated. Rutile, anatase, brookite and pseudo-brookite were all identified. Tourmaline, staurolite, garnet and some other minerals are also spoken of in the same connection, and a long list of localities given where all these substances were observed.——Kalkowsky[2] finds that in certain rocks, especially nepheline-basalts from Randen in the Hegau, Baden, and from Tharand in Saxony, twins of olivine are quite common. The twinning plane is a brachydome whose angle over OP is nearly 60°, as was observed by vom Rath in free crystals of monticellite from Mte. Somma.——Knop[3] has made a thorough chemical study of the augite occurring in the various rocks of the Kaiserstuhl in Baden. One group is interesting on account of their containing TiO_2, the amount sometimes exceeding four per cent. This would naturally be supposed to isomorphously replace SiO_2, but on account of the violet color of the augite in which titanium is most abundant, it is suggested that this element may also be present as Ti_2O_3, replacing ferric iron.——Schuster[4] adds over 200 pages to his former paper on the crystallography and structure of danburite, making his numerous and careful measurements the basis of general conclusions regarding the nature of forms possessing very large indices, to which Websky has applied the name "*vicinal-planes.*" For the many important results obtained, reference must be made to the original article. Vicinal-planes are found (p. 490) to possess a definite relation to some principal plane having simple indices, with which they are associated. This relation is a genetic one. Vicinal-planes are regarded, so to speak, as "induced" by the joint action of two forces, one exercised by the new molecules in their effort to form a really new plane and the other exerted by the old plane to retain its exact position.——The crystalline form of the element thorium has been for the first time determined by Brögger.[5] Although apparently rhombohedral, the minute crystals (only 0.15^{mm} wide and 0.015^{mm} thick) are really regular, being a combination of a cube and octahedron.——Schaeffer[6] describes a new American locality for tantalite, the Etta tin mine in Dakota. Its composition is $TaO_2 = 79.01$; $SnO_2 =$

[1] Ueber das Vorkommen mikroskopischer Zirkone und Titan-mineralien. Würzburg, 1884.

[2] Zeitschrift für Krystallographie, Vol. x, p. 17, 1885.

[3] Zeitschrift für Krystallographie, Vol. x, p. 58, 1885.

[4] Tschermak's Min. und Petr. Mittheilungen VI, pp. 301–515, 1885.

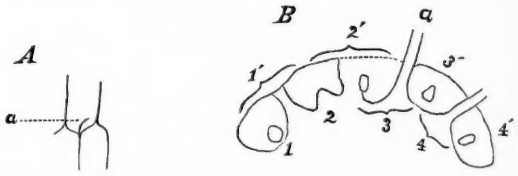
[5] Meddelanden från Stockholms högskola, No. 1, 1883.

[6] American Journal of Science, Dec., 1884, p. 430.

0.39; FeO = 8.33; MnO = 12.13; total 99.86. Sp. gr. = 7.72. ——Hidden[1] mentions a new locality in Colorado for phenacite, xenotime and fayalite, also another for rutile, emerald and hiddenite (spodumene). A crystal of zircon from Burgess, Canada, gave the same author a new plane $\frac{1}{3}$P not hitherto observed in this mineral.

BOTANY.[2]

THE NODE OF EQUISETUM.—If a section is made lengthwise through a node of a fertile stem of *Equisetum arvense*, each vascular bundle is seen to divide into two parts, each part uniting with a corresponding part of an adjacent bundle to form one of the bundles of the next internode (Fig. *A*.). If the section be



A. Showing the branching of the bundles at the node, seen longitudinally. *B*, a horizontal section of a portion of the bundle ring in a node.

made radially through one of the teeth of the sheath or rudimentary leaves, a bundle is seen to pass down and unite in the node with one of the bundles of the stem. Fig. *B*, a horizontal section in the node of a portion of the bundle ring, shows how this leaf bundle originates. It is seen that the bundle of the leaf is derived, not by a simple separation of a portion of the outer phlœm, part of the bundle in the stem, but that it originates where that bundle begins to divide, and in such a manner that its vessels are continuous with the xylem of the divided bundle.

Each bundle of the stem therefore divides at the node in three parts—two lateral portions, each with xylem and phlœm, which by rearrangement continue the bundles of the stem, and a central part which bends outward into the leaf.

In Fig. *B*. bundle 3 has divided, and given origin to the leaf bundle *a*, and two lateral portions, one of which has united with half of the divided bundle 4 to form the perfect bundle 3′, the other half being ready to unite with half of the dividing bundle 2 to form a bundle at 2′. A section a very little farther up would show bundle 2′ completed and bundle 2 in the condition that 3 now is. As the leaves do not arise quite on the same horizontal plane successive sections show the process repeated both to the

[1] American Journal of Science, March, 1885, p. 249.

[2] Edited by Professor CHARLES E. BESSEY, Lincoln, Nebraska.

right and left until the opposite side of the stem is reached, and as many leaves have been produced as they are bundles in the stem.—*A. A. Crozier, Botanical Laboratory, University of Michigan.*

Dispersion of Spores in a Toadstool.—A few days since I collected specimens of *Agaricus illudens* for use in my class in botany. I placed the fungi on my table to remain over night that I might in the morning be able to show the color of the spores. What was my surprise on examining my specimens in the morning to find spores in great abundance, not immediately beneath the pileus, but shot out in every direction to the distance of from six to twelve inches, and I know not how much further, as the greater distance named reached the edge of my table. In one direction a roll of paper interrupted the flight of the spores, and from the surface of the paper the little bodies were reflected back in the direction of their origin, and falling finally upon the table formed quite a little drift of accumulated spores, thus showing that the projectile force in operation was strong enough to cause at a considerable distance a very decided rebound.

Such means for the disposal of the spores I have never before observed either in connection with this or any other agaric, nor have I seen notice of such a phenomenon. The atmosphere of my room was at the time very dry, and this fact undoubtedly had something to do with the remarkable distribution described.—*—T. H. McBride, Iowa City, Oct., 1884.*

The Fertilization of Cuphea viscosissima.—The entire plant is clammy pubescent, especially the stems and calyces. There are six petals, purple, the two upper ones about twice the size of the rest, the four lower ones being placed along the lower edge of the calyx (Fig. 1 *A*). The lower part of the calyx near the throat is inflated, and the base is spurred (Fig. 1 *B*). On the

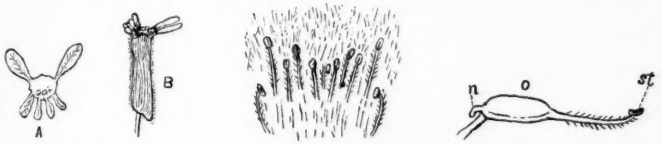


Fig. 1. Fig. 2. Fig. 3.

Cuphea viscosissima. × 1¾.

Fig. 1.—*A*. View of corolla from above. *B*. Side view of flower. Fig. 2. Corolla split open to show the relative position of stamens, magnified. Fig. 3. The pistil. *n*, nectary, *st*, stigma, *o*, ovary.

lower part of the calyx near the inflated portion are inserted the stamens at different heights, generally eleven, the two outer ones being decidedly lower than the rest, while the nine are arranged in two sets, one shorter than the other (Fig. 2). The ovary has a projection towards the base which enters the nectary of the

calyx, and supplies the honey; the stigma is two-lobed, the lower lobe being decidedly smaller (Fig. 3). There is a decided variation in the length of the style, but I was unable to deduce any dimorphic arrangement from what I saw. Long-tongued bees visit the flower, and the case seems one of synacmy, the outer stamens, however, maturing first, and the next in order.—*Aug. F. Foerste, Granville, Ohio.*

THE INTERNAL CAMBIUM RING IN GELSEMIUM SEMPERVIRENS.—Dr. J. T. Rothrock, at the meeting of the Botanical Section of the Academy of Natural Sciences of Philadelphia, held February 9, 1885, called attention to the internal cambium ring in the stem of *Gelsemium sempervirens.* It might well be designated as the inner cambium. His attention was attracted by the fact that in a *stem* of three-eighths of an inch diameter, the pith was actually less in diameter than in a *twig* of a quarter the size of the *stem.* Microscopic examination showed that in the larger stem there were ordinarily four or more points, at which a well-defined swelling curved inward from the circumference of what should have been the pith-cavity. These swellings resolved themselves when closely examined into:

1. Toward the center an imperfectly defined membrane, resembling cuticle, which was not always present.
2. One or more rows of large cells like the parenchyma we find under the epidermal layer.
3. Several poorly defined layers of smaller cells, such as often mark the limits of growth in bark.
4. The frequent presence of bast fibers or of sclerenchyma cells.
5. An evident layer of thin-walled, square cells, closely resembling, though somewhat smaller than those of the external cambium. They showed signs of division, which indicated that they were still a living tissue.

These facts explained at once why the pith was constantly being encroached upon until it at length almost disappeared. The medullary rays dipped down through, and widened out, in this inner cambium, *inwardly*, just as they did *outwardly*, in the usual form of cambium layer. He also remarked that bast fibers had long been known to exist in the pith of *Tecoma radicans*, and in this case something like an inner cambium would be found, though it is more obscure. *Sambucus canadensis* also exhibited in the very large stems a smaller pith than in those of moderate size. In this there was nothing comparable to the inner cambium. He also remarked that for the past two winters his attention had been called to the presence of considerable quantities of chlorophyll in the pith of *Lycium vulgare.* This was not confined to the smallest stems, but was found also in those of over a quarter of an inch in diameter, and where of course a considerable belt of

hard wood was found between the pith and the outer zone where chlorophyll is expected. It was also observed in Lycium that the chlorophyll was not in the form of bodies, but diffused in character, as it is said to be in some infusorians. In Lycium the cells of the pith showed, in winter, abundance of protoplasm which had the nucleus on one side and very striking bands extending thence across the cell to the further side.—*Proc. A. N. S. Phila.*

STRASBURGER'S BOTANISCHE PRACTICUM.—About a year ago this book appeared in Germany, where it has received many favorable notices, as an excellent work for the laboratory student. The book is so valuable that it must soon be translated, but in the meantime we may well give an outline of what it contains. After an introductory chapter devoted to the microscope, various kinds of apparatus, reagents, staining fluids, etc., etc., the work is divided into thirty-four "tasks," in which particular subjects are taken up. The aim of the author is to train the student at once in microscopy and botany, rightly believing that the art named can be best learned in its application to the science of plants. As far as possible the plants selected are common and easily obtainable ones. The illustrations, of which there are 182, are all new, and are made especially for this work.

The general sequence of subjects is as follows: Starch, aleurone, protoplasm, chlorophyll and other coloring matters; crystals; anatomy of the root of sugar-beet; fruit of pear; epidermis and stomata of Iris, Tradescantia and other plants; hairs of various plants; fibro-vascular bundles of Indian corn, oats, palm, Ranunculus, Aristolochia, etc., etc.; secondary wood, anatomy of stems of Scotch pine, linden, ivy, locust (Robinia), pumpkin, etc., etc., running through twenty "tasks" or chapters. A couple of chapters are devoted to the structure and reproduction of mosses, five to the fungi and algæ, one to the reproduction of pteridophytes, another to that of conifers, and five to that of phanerogams proper.

A smaller edition has appeared in Europe, but this we have not yet seen. We trust that a translation of either the larger or the smaller work will be placed before the English-speaking students of this country. There is certainly room for such a book here.—*Charles E. Bessey.*

THE PAMPAS.—In answer to the statement of Professor Asa Gray, following Darwin and Ball, that the pampas of South America are treeless because the only country from which trees could be derived could not supply species suitable to the soil and climate, Mr. Edwin Clark puts forward, in a letter to *Nature*, what he, from long residence and observation, believes to be a more probable cause or series of causes. From the absence of rivers or water storage, periodical droughts (siccos) occur in the

summer, and at such seasons the droves of horses and cattle and the numerous aboriginal wild rodents destroy every vestige of vegetation in their efforts to live, the cattle even tearing out the roots of the pampas grass. The existence of an unprotected tree is impossible. Nothing survives save thistles, some grasses and clovers, a few poisonous plants, thorny dwarf acacias and wiry rushes. The extensive introduction of European plants has only added to the flora of the pampas a few species, such as two thistles that are unassailable by cattle. Yet the soil is fertile and trees grow luxuriantly wherever they are protected.

BOTANICAL NOTES.—The odd tree known to the Mexicans by the name of Ocotilla, and to botanists as *Fouquieria splendens*, a native of the Rio Grande plateau region, has been made the subject of chemical studies by Miss Helen C. De S. Abbot, of the Philadelphia College of Pharmacy, the results of which have lately been published in an eight page pamphlet. A new vegetable wax was discovered in the bark, to which the name of Ocotilla wax was given.——Dr. Farlow's paper on the Synchitria of the United States, in the March *Botanical Gazette* is of unusual interest. It contains descriptions of all the species known to exist in the United States, ten in all.——The Botanic garden of Buitenzorg, Java, founded in 1817, consists of ninety-one and a half acres, and contains more than nine thousand species of plants, each represented by two specimens. Connected with the garden is a botanical museum, containing the herbarium, a collection of vegetable products, and the library, with facilities for drawing and photography. All this is in far-off Java! When may we hope for that kind and amount of state help in this country which will enable our botanists to begin the making of botanic gardens worthy of the name?——As showing the tendency in our best universities we note that, according to an item in the *Gardeners' Monthly*, the University of Michigan "has established a chair of forestry in connection with its other branches of education."——The University of Nebraska has made an appropriation of five thousand dollars for procuring apparatus and collections for its department of botany.

ENTOMOLOGY.

REPRODUCTION IN THE HONEY-BEE.—At a late meeting of the Royal Microscopical Society, Mr. Cheshire exhibited and explained four preparations—three of spermatozoa and one of the muscles of the valve of the receptaculum seminis of the queen bee, which he had recently succeeded in dissecting, and of which he gave an interpretation at a previous meeting. The muscles were shown under polarized light with the prisms crossed, so that two sphincters which overlap, and the fibers of which cross, can be dissected. One resolves the polarized beam completely, while

the other gives no twist to the plane of polarization, and so remains invisible; but by rotating the stage plate the latter muscle shines out brightly as the former retires into darkness. Mr. Cheshire finds this method of studying muscular layers in insects of great service. The spermatozoa from the queen bee were exhibited in a dense bundle containing hundreds of thousands of individuals arranged parallel in a tortuous line, and it is in this way that they are packed in the spermatheca, which, in a recently fertilized queen, will contain from four to ten millions of them. The second preparation—an extremely beautiful and curious one—presented the spermatozoa (in this case taken from the vesicula seminalis of the drone) in separation from one another. The contents of the "vesicula" being diluted with water upon a warm slide, the spermatozoa, by their spontaneous movements, spread themselves in a perfectly regular and compact single layer, each individual twisting itself finally into a regular figure like two 8's, surrounded by a larger O. Each spermatozoön is not less than 250μ in length. Spermatozoa from the queen wasp was the third object. These spermatozoa, about 200μ in length, are extremely thin, and carry no visible head, although the ends are not equal in diameter. They take the same typical form as those of the bee. Mr. Cheshire states that for insect spermatozoa he prefers Spiller's purple as a stain. In his remarks he called attention to the curious fact that if a drone larva be introduced into a queen's cell while she is passing through the chrysalis condition, the artificial aperture by which the drone larva was introduced, being afterwards carefully closed, the queen will hatch out already fertilized and capable of at once laying eggs which will produce workers. This remarkable fact seems to open up the way for quite a new method of investigating a certain class of insect phenomena.—*English Mechanic.*

Life-histories of Mites.—At a late meeting of the Royal Microscopical Society, Mr. A. D. Michael read a paper "On the Life-histories of some little-known Tyroglyphidæ." In 1873 Riley published a report on the ravages of the apple-bark louse (*Aspidiotus conchiformis*), and described an acarus which was supposed to destroy that pest, and which he thought might be the *Acarus mali* of Shimer. Riley only describes the female. Mr. Michael has found the acarus in England under the bark of reeds, destroying the reeds, not feeding on any insect, and concludes that it is probably a feeder on various kinds of bark, not on animal life. He has traced the whole life history. The male (previously unknown) presents the exceptional features possessed by the male of *Tyroglyphus carpio*, discovered by Kramer in 1881, and the hypopial nymph has been figured by Canestrini and Fanzago in 1877 under the name of "parasite of an Oribata," but without explanation. Mr. Michael finds in the life history of this

hypopus a confirmation of his views that the hypopial stage is not caused by exceptional adverse circumstances, as Mégnin supposes; but is an ordinary provision of nature to insure the distribution of the species, which it is intended to call *Tyroglyphus corticalis*. Mr. Michael also called attention to the prevalence of *Rhizoglyphus robini* on Dutch bulbs imported into England in 1884, and to the destructive nature of that species, and the damage it did to hyacinth, dahlia and Eucharis bulbs, &c., and recommended that imported bulbs should be carefully examined. —*English Mechanic.*

Firefly Light.—MM. Aubert and R. Dubois have recently made a number of interesting observations on the light emitted by "pyrophores," or fire-bearing insects of the family Elateres, genus Pyrophorus. These pyrophores have three luminous organs, one situated at the ventral part, and two at the superior part of the prothorax. The last are always visible, and were submitted to the tests. The light was produced by rubbing the insect with a light brush, and was examined by means of an ordinary spectroscope with a prism of very refrangible glass and a micrometer. The spectrum was very fine, continuous, and showing neither brilliant nor dark rays. This peculiarity has already been pointed out by Pasteur and Gernez, who studied the light from a pyrophore belonging to the late Abbé Moigno, editor of *Les Mondes*. The spectrum occupied about seventy-five divisions of the micrometer, and extended on the red side to the middle of the interval which separates the rays A and B of the solar spectrum, and on the blue side a little beyond the ray E. When the intensity of the light varied, its composition changed in a remarkable manner. When the brightness diminished the red and orange disappeared entirely, and the spectrum consists of green, and a little blue and yellow. The green rays lasted longest. The contrary took place when the light grew in brightness, the green appearing first and spectrum extending a little on the blue and a great deal on the red side. The least refrangible rays are, therefore, emitted last. No other luminous source known appears to behave in like manner. The only case which bears a resemblance is that of sulphate of strontium becoming phosphorescent under the action of light at a glowing temperature. As the temperature rises, rays less and less refrangible appear in the spectrum, but at the same time, as Edmond Becquerel has shown, the less refrangible rays disappear. When the light of the organ begins to appear, the central and forward part only of the organ is luminous. It is only when the light is very bright that the periphery of the organ is luminous, and then the red rays are visible. The light was found to give photographic images on a gelatino-bromide plate; the insect being two centimeters from the plate, and the time of exposure reduced from an hour to five minutes. The photographs show that the light of the pyrophore

is capable of producing intense chemical effects, if the smallness of the quantity emitted be taken into account. The light also determines the phosphoresence of sulphate of calcium, after an exposure of five minutes; and eosine and azotate of uranium are rendered fluorescent by it.

The foregoing is taken from an exchange; the first spectroscopic research in firefly light was those of Professor C. A. Young, published in this magazine, vol. III, p. 615, 1870.

USE OF AN ADHESIVE FLUID IN JUMPING INSECTS.—Dr. Dewitz has described the use of a sticky fluid by insects in jumping. A Cicada in a closed glass tube is able to jump from the bottom on to the cover, and from one vertical side to the other, turning in the air; the contingency of having to jump on to vertical surfaces, or the under side of horizontal surfaces, occurs also in Nature—viz., in the case of stems and leaves, which are, moreover, smooth, so that claws are ineffectual to support the insect, and sucking-disks would probably not act with sufficient rapidity. Now, the leaping spiders possess a well-developed pedal adhesive apparatus, by the aid of which they can remain attached to the surfaces on which they alight; the glands which secrete the liquid open all over the balls of the feet, and are especially numerous at their bases.

ENTOMOLOGICAL NOTES.—We glean from the *Zoölogical Record* for 1883, such notes as are of general interest.——Klemensiewicz publishes detailed observations on the glands of the skin of caterpillars.——As the respiration of insects, says Langendorf, depends on abdominal movements, it may continue after the removal of the head. The number of respirations is increased by heat. Tobacco-smoke and chloroform lead to intermittent, but more or less rhythmical respiration for a time. The head and prothorax may be removed, and the respiration will continue; and if the abdomen of a dragon-fly is cut to pieces, respiration will continue in them, thus showing that each abdominal segment possesses its own respiratory center.——Osborne finds that in the European *Zaræa fasciata*, the color of the cocoon depends on the food, larvæ fed on strawberry forming dark-brown resinous cocoons, and those fed on honeysuckle forming pale-greenish cocoons. In this saw-fly parthenogenesis is the rule.——H. Müller states that bees in unaccustomed localities are timid, and find honey with difficulty, but rapidly become accustomed to their surroundings, especially under the guidance of comrades. Different bees exhibit a preference for certain flowers over others, but very brilliantly colored flowers are less attractive than those of more subdued colors. The results of a long series of experiments are summed up with the conclusion that blue or violet are the most attractive colors, and bright yellow the least so.——At the suggestion of Darwin, Fabre undertook a series of experiments to

test the power of bees to return to their nests when carried to a distance; a considerable number returned safely.——*Ammophila hirsuta*, says Fabre, searches for the larvæ of *Agrotis segetum*, which are detected under the surface of the ground by some apparently unknown sense. The larva is carefully paralyzed in every segment before being buried, which leads the author to conclude that the Ammophila originally preyed on insects more easily paralyzed, and as it gradually attacked larger insects, its instincts enlarged, and became hereditary.——W. F. Kirby finds that hybrids between *Smerinthus ocllatus* and *populi* usually show traces of hermaphroditism, which seems to indicate that hermaphroditism is encouraged by hybridity, and that the usual sterility of hybrids may be due to this cause.

ZOOLOGY.

Another Vorticella with two Contractile Vesicles.—In the Naturalist for August, 1884, the writer described a new infusorian belonging to the genus Vorticella, under the name *Vorticella lockwoodii*, one of the peculiarities of which was the possession of two contractile vesicles, that being the first recorded instance of the occurrence of more than a single pulsating vacuole in any of the numerous species. Now, however, I desire to state that a similar arrangement obtains in the well-known *Vorticella monilata* Tatem, a species originally discovered in English waters, and by no means uncommon on the continent of Europe or in this country. It therefore seems somewhat surprising that the presence of the two vesicles in this widely distributed form should have hitherto eluded observation. The species occurs in this locality in some profusion, a colony recently taken attached to Myriophyllum from my aquarium being formed, by actual count, of two hundred individuals, another of eighty-three, smaller collections not being rare. With these I have been able to positively determine and demonstrate to a friend the presence of two contractile vesicles which, when the vorticella is in the proper position, are distinctly visible without a change of focus. The fact of their presence is of interest since it is a point in the anatomy of these minute creatures not previously noted.—*Dr. Alfred C. Stokes, Trenton, N. J.*

Cuvierian Organs of the Cotton-spinner.— Professor F. Jeffrey Bell gives a technical account of this almost unknown British Holothurian, which is of interest as being the only true —that is, aspidochirotous (or with shield-shaped tentacles)— member of the class which is known to occur in British seas. The organ of most importance is that which produces the sticky secretion from which these animals have obtained their name, and which makes them objects of much dread to the Cornish fishermen. The producing or cuvierian organs are described as forming a solid mass which occupies a large portion of the body-

cavity, and which is made up of a number of separate tubes; a small coiled portion was found lying in the cloaca as if ready for ejection. A small piece of a tube, measuring only 2.5$^{mm.}$ was found even after twenty years' immersion in spirit, to be capable of extension to twelve times its own length; while, when treated with water, the attenuated thread swells up to seven times its own breadth. "We can thus understand that an animal at whom these threads are thrown should, as it attempts to escape, lengthen the threads which, at the same time, coming into contact with the water, would be swollen out transversely as they were extended longitudinally." Professor Bell thinks that the observations confirm the view of Semper as to the protective or offensive character of these organs, which, by Jäger and most later anatomists, have been thought to be renal in function.

In a subsequent note Professor Bell states that six threads, any one of which was only barely visible, were capable of supporting a weight of nearly a thousand grains; and quotes a letter from a correspondent to say that the black holothurians near Porto-Fino, emit a tangled mass of white threads so sticky and in such quantity that it was difficult to free the hands from them.—*Journal of the Royal Microscopical Society, December, 1884.*

Earth-Worms.—An interesting paper on the habits of earthworms in New Zealand is contributed to the New Zealand Institute by Mr. A. T. Urquhart. The species are not named, but with such wonderful opportunities as Mr. Urquhart possesses for making a collection of these, may we hope that, in addition to his following out his observations as to their habits, he will also advance science by making a careful collection of the forms and placing them in the hands of some of the able naturalists of the Auckland Institute for description? It will be remembered that Darwin assumes that in old pastures there may be 26,886 worms per acre, and that Hensen gives 53,767 worms per acre for garden ground and about half that number in cornfields. Mr. Urquhart gives, as the result of his investigations of an acre of pasture land near Auckland, the large number of 348,480 worms as found therein. It being suggested to him that in his selection of the spots for examination he may have unconsciously selected the richest, the experiment was again tried in a field seventeen years in grass. A piece was laid out into squares of 120 feet, and a square foot of soil was taken out of each corner; worms hanging to the side walls of the holes were not counted, and in one hole, where the return of worms was a blank, the walls were crowded with worms. As a result there was an average of eighteen worms per square foot, or 784,080 per acre. Although this average is very striking when compared with that of Hensen, it is worthy of note that the difference between the actual weight of the worms is not so marked. According to Hensen, his average of 53,767

worms would weigh 356 pounds, while Mr. Urquhart finds that the average weight of the number found by him came to 612 pounds 9 ounces.—*Scientific American.*

Deep-sea Explorations of Last Summer by the U. S. Fish Commission.—Professor Verrill reports that the zoölogical results this year were of great interest. Many additions to the fauna of great depths were made, and a large proportion of them are undescribed forms. Some of the fishes were of great interest. Huge spiny spider-crabs (*Lithodes agassizii*) over three feet across were taken in 1000 to 1230 fathoms, and another very large crab (Geryon) occurred in great abundance in 500 to 1000 fathoms, while in 2574 fathoms a large and strong crab-like creature (Munidopsis) was taken. Many curious shrimp, some of them of large size and brightly colored, and often with perfect eyes, occurred in most of the deepest dredgings. Several very interesting new forms of star-fishes, ophiurans, and holothurians were dredged, some of them in large quantities, even in the deepest localities. Several interesting new forms of corals, gorgonians, sea-pens, and allied forms also occurred. Numerous specimens of huge sea-urchins with flexible shells (*Phormosoma uranus*) were obtained from several different stations, in 600 to 1100 fathoms. Some of these are about ten inches broad. One sea-urchin (Aspidodiadema), not before observed north of the West Indies, was taken in 991 fathoms. Most of the deep-sea star-fishes belong to the genus Archaster and other closely related genera. Some of these, like *A. agassizii* and *A. grandis*, were taken in large numbers, several hundreds in a single haul. And the same often happens with several of the ophiurans and sea-urchins. One interesting stalked crinoid (Rhizocrinus) was obtained in 2021 fathoms.

Many additions were made to the Mollusca. In July, Professor Verrill published a general list of all the deep-water Mollusca taken in the gulf stream region off this coast, up to the end of 1883. That list included 338 deep-water species and 42 that inhabit the surface waters. This year about 25 deep-sea species and about 8 from the surface were added to the list, making the total number over 400 species. Among the new forms discovered this year are four or five species of cephalopods, some of them very remarkable, and representing new genera. There were some very interesting new shells, some of them of good size and well developed, from below 2000 fathoms. Most of the larger and finer ones from the very deep waters belong to the Pleurotoma group, but some large species are allied to Sipho (or Fusus) and to Dolium. Numerous specimens of three rare species of brachiopods were also dredged from below 1000 fathoms. These are *Discina atlantica*, *Waldheimia cranium* and *Atretia gnomon*. The latter has not been known before from this side of the Atlantic.

Anatomy of a Catfish.—Professor R. Ramsay Wright, with Professor J. P. McMurrich, A. B. McCallum and T. McKenzie,

have published in the Proceedings of the Canadian Institute of Toronto "Contributions to the anatomy of Amiurus." The papers serve as a contribution to the morphology of a comparatively little known family of fishes, and will also be of use to teachers of comparative anatomy. The skin and cutaneous sense-organs as well as the nervous system and sense-organs are described and figured by Professor Wright; the osteology and myology by Professor McMurrich, the alimentary canal, liver, pancreas and air-bladder by Mr. McCallum, which Mr. McKenzie has worked out the blood-vascular system, ductless glands and urogenital system. The work comprises 206 pages, and is illustrated by eight folding heliotypic plates.

Professor Wright describes certain structures which are apparently comparable to the nerve-sacs of the ganoids; he also discusses the relationship between the air-bladder and the auditory labyrinth. The work is another of the monographic essays now appearing from time to time, and affords the modern student aids and facilities such as were entirely unknown a generation ago.

The Spiracles of Amia and Lepidosteus.—My note on this subject in the February Naturalist requires modification, in so far as what I took to be the oral aperture of the spiracle in Amia is really the aperture of a canal in which the pseudobranchia lies, and into which the spiracular cleft opens further forwards. The pseudobranchia of Amia is homologous with the upper (non-respiratory) part of the opercular gill in Lepidosteus; both are innervated by the anterior branch of the glossopharyngeus, but the pseudobranchia of Lepidosteus is free, while that of Amia is concealed in what may be termed a pseudobranchial canal. The singular continuity of this canal with the spiracular cleft induced me to believe that I had found evidence to justify Dohrn's criticism of Gegenbaur's views as to the homology of the pseudobranchia of the Teleosts, but I am now convinced that the condition of the parts in Amia proves Gegenbaur's position to be correct.—*R. Ramsay Wright, University College, Toronto, February 10, 1885.*

Birds out of Season—a Tragedy.—Our winter so far has been one of unusual severity, such low temperatures as — 20° to — 35° having prevailed quite often. Whole weeks have passed in which the mercury has not risen above zero! But during all this time, until the afternoon of the 18th instant—"a chewink" (*Pipilo erythrophthalmus*) has lived about my orchard and barnyard. I am unaccustomed to seeing much of this species, except in early spring, upon their return from the South. It breeds here, but is a very quiet bird through the summer and autumn—at least, it has only been upon rare occasions that I have seen it. But soon after winter set in I saw the one in question in the barnyard, where he seemed to be feeding upon some scattered grain. Later I found him one very cold afternoon in a "straw-built shed,"

where I easily caught him. After looking him over, and comparing him with Dr. Brewer's lucid description, I let him go. Catching him did not seem to have caused him any alarm or discomfort, for he remained about the premises quite as tame and sprightly as usual.

In addition to the chewink, a robin has also been a frequent visitant here. We saw him some days ago, and again last night, when the mercury was down to — 20°. But it is not at all unusual for robins to be here in winter, though I do not remember having ever seen more than one at a time.

On the afternoon of the 18th instant, our dear little chewink, which we had come to regard with great solicitude, met with a very sad fate. Going into the barnyard, I saw a couple of birds dart down to the side of a hay-stack. One was a jay, and at the first glance I thought the other was also. But in an instant it occurred to me that the jay was killing the under bird. I sprang forward hoping to rescue it. I was just an instant too late—for the jay picked up the bird, now dead, and flew away with it! The load was a heavy one, and as the cannibal flew off across a ravine, it bore him down almost to the ground. The quick glimpse I had of the glossy black head and back, the chestnut sides, and the white under parts, showed that it was our poor chewink—whose fortitude in braving our terrible winter had met with a sad requital. I have always defended the blue jays, though I know they are addicted to a great deal of "crookedness" in their treatment of other species of birds; but this incident has quite disgusted me with them.—*Charles Aldrich, Webster City, Iowa, Jan. 29, 1885.*

How far does the Jerboa Jump?—On page 71, of his most entertaining volume, A Naturalist's Rambles about Home, Dr. Charles C. Abbott, in speaking of the pretty "kangaroo or jumping-mouse," quotes Godman to the effect that it leaps "five or six feet at every spring;" but expresses a doubt on the subject. He says: "Without the means of determining this point, I should judge that one-half that distance was more nearly correct." While living at my old boyhood home, in Cattaraugus county, New York—forty years ago—I used occasionally to see one of these very interesting little animals. The first one I ever saw was in the meadow, where I was raking hay with a common, old-fashioned hand-rake. The mouse made a sudden spring, and I "went for it" with my rake. After chasing it two or three rods I hit it with the rake-head and killed it. My recollection is very distinct, that it "leaped at least five or six feet," at the start —though it appeared to tire out very quickly, reducing the length of its leaps to not more than two or three feet. I conclude that both writers have recalled their observations correctly, and that the condition of the animal, possibly also its age, may determine its jumping capacity. I remember that in this, as in other

instances, each jump was made in a different direction from the last, so that it was a matter of some difficulty to pursue the little creature! I was exceedingly interested in this first capture—never having seen or heard of one before. One of our farm hands told me that it was a "kangaroo mouse." After that I saw one occasionally, and my recollection is very clear that Godman does not overstate its ability to jump. I have never seen or heard of one in this region.—*Charles Aldrich, Webster City, Iowa, March 5, 1885.*

EMBRYOLOGY.[1]

ON THE PROBABLE ORIGIN, HOMOLOGIES AND DEVELOPMENT OF THE FLUKES OF CETACEANS AND SIRENIANS.—We have seen that the development of the Physoclist fishes (AM. NATURALIST, 1885, pp. 315–317), shows that the translocation of the pelvic fins forward is accomplished in some forms in about twenty-four to forty-eight hours, to a position more or less in advance of the pectoral. If a limb-fold can be translocated forwards in a vertebrate embryo from its archaic site, there is no reason to doubt that under certain conditions it might be translocated in the other direction or backwards. A process of translocation of the distal end of the pelvic limbs seems to have occurred in the cetaceans, as a consequence of which the pes has acquired a new position far to the rear of that which it occupies in normal mammals, and this seems to have been accompanied by processes of atrophy in some directions and hypertrophy in others.

The researches of Struthers, Flower, Reinhardt, Eschricht, Kaup, Lepsius, Howes and Wilder, leave no doubt as to the fact that the different rudimentary structures which these anatomists have detected, unequivocally point to the conclusion that, the cetaceans and sirenians have descended from Mammalia which possessed more or less perfectly developed ambulatory limbs, which fitted them at least for an amphibious or partially terrestrial existence. This conclusion is, I believe, generally accepted by recent authorities.

All recent writers, amongst which may be named Flower, Huxley, Owen, Claus and Parker, unequivocally declare that the hind-limbs of the whales and sirenians have been so completely suppressed, that no rudiments or vestiges of any kind have remained to indicate outwardly that these creatures ever possessed such appendages, the evidence that they did once possess hind-limbs resting for them rather upon the presence of a rudimentary pelvis with much reduced limb-bones in a few forms of Balænoidea and in Halitherium.

From this view the writer must dissent, having independently arrived at conclusions in reference to the homology of the flukes

[1] Edited by JOHN A. RYDER, Smithsonian Institution, Washington, D. C.

very similar to those published by Professor Gill[1] in 1882, who regards these characteristic structures as having been derived from greatly hypertrophied integuments of hind-limbs analogous to such as are developed, for instance, to the hind-limbs of the eared seals, while the osseous elements have been inversely atrophied, pulled forwards, and reduced to supports for muscles connected with the organs of generation. It may, I think, be regarded as a fact that there is no evidence to show that development does not attempt to recapitulate in a disguised form, in the cetacean fœtus, the outgrowth of the hind-limb as seen in a normal mammalian embryo.

In the mammal the pectoral limb is the first to appear, the pelvic appearing last. If the flukes be regarded as the outward vestiges of hind-limbs or pedes, then will the embryos of cetaceans and sirenians conform to this law presiding over the order of appearance of the limbs, which, so far as I am aware, is regnant without exception within the limits of the vertebrate class. The dorsal fin with which the flukes have so often been mistakenly compared, is not present in all cetaceans; is absent in all sirenians; is not constant in position in different genera of the former; is sometimes a mere carina, dorsal ridge or hump; its vascular and nerve supply is different from that of the flukes; it develops after the latter, showing that it is a later acquirement; it has absolutely no connection with muscles directly or indirectly by tendons as have the flukes, so that I regard the comparison of the dorsal fin, which is a mere dermal fold, with the flukes, as expressing a mistaken apprehension of anatomical homologies, and not justified in the face of the fact that the flukes are never absent, and always appear laterally or serially in the position of a hind limb-fold, though backwardly displaced. It must, however, be stated that I distinctly disavow the affirmation that the flukes are homologous with more than the pedes of normal forms. The older views which intimated that the flukes were the representatives of limbs or of feet, it is not worth while to discuss, as these writers did not possess the data upon which to base any reasons for their opinions, which seem to have been in the main intuitional.

The hypothesis which is offered to account for the flukes as the distal vestiges of limbs rests upon the following arguments:—1. The mode of outgrowth of the flukes in the embryo, prior to the dorsal fin, at the end of the sides of the tail, at first as a pair of low rounded lobes or folds of skin, containing mesoblast, which become gradually falcate, and which expand posteriorly so as to leave a notch over the end of the tail between their inner edges. The hind margin of the flukes answering to the terminal border of the pes or the ends of the suppressed toes or the integuments extending beyond them, and their anterior margin to the outer

[1] Scientific and popular views of nature contrasted. A lecture delivered in the National Museum, March 11th, 1882. Pp. 10–11. Washington, Judd & Detweiler.

digital border. 2. The existence of a small median papilla, according to Wilder, at the extreme end and under side of the tail of the fœtus of the manatee, representing apparently the last vestige of an exserted tail extending beyond and behind the fluke folds of this type, in which the flukes are in fact rudimentary. 3. The fact that the osseous elements of the limb have atrophied exactly in the reverse order in which they appear in the embryo, or from without inwards, that is, from behind forwards in cetaceans and sirenians, because in both, the hind-limbs have been rotated or extended permanently backwards distad of the knee-joint. 4. The structure of the embryonic fluke-folds or diverticula filled with mesoblast comparable to that found in the limb-folds of other vertebrate embryos, these limb-buds representing structures which have survived translocation and made an attempt to imperfectly recapitulate the development of part of the limb.

The above headings present the embryological argument. The other data are anatomical and are mainly based on a comparison of the pinniped and cetacean types. Admitted that the cetaceans are descended from land forms, we would naturally look to types of amphibious habits and poorly adapted for progression upon land to furnish the first indications of modifications which have been carried to an extreme degree in the former. Traces of the beginnings of such modifications we actually find in pinnipeds.

In the pinnipeds, the hind limbs, from the knees, have been rotated backward and included by a continuation of the integument which invests the body together with the tail, leaving only the last two or three short caudal vertebræ exserted or projecting into a caudal integumentary pocket, lying between the distal parts of the backwardly extended limbs. This process of inclusion, if carried to an extreme stage, would finally cause the whole of the tail to be lost to sight outwardly, leaving only the metapodial and phalangeal parts free. As a result of this arrangement in the pinnipeds certain muscular insertions of the limb muscles have been moved backwards, and the hyposkeletal flexors of the trunk have become more powerful; the abdominal muscles extending over the knees have restricted the movements of the femur. As a further result of this restricted movement the pelvis has begun to degenerate, the symphysis pubis become less defined, and the femur shortened. We are therefore, I submit, the actual witnesses of a process in the pinnipeds which if carried still further would bring about the condition now found in living cetaceans. The pedes in pinnipeds have been hypertrophied together with the metapodial and phalangeal elements, but are not the fingers also lengthened and their joints multiplied in the cetacean manus? In the Plesiosauri, Ichthyosauri and Lyrifera or true fishes, the same thing has occurred, namely hypertrophy and lengthening or increase of limb-elements comparable to phalanges, with a corresponding shortening of the proximal bones in contact with

the shoulder and hip-girdles. Manifestly the pes of a form like Megaptera, if mobile, would require a system of phalanges as powerful as those in the manus, but the pes is not mobile in any cetacean, on its own base, as is the fore-limb, but is rigidly affixed to the sides of the end of the tail and incapable of independent movement, hence the atrophy of its bones. The only evidence remaining to indicate that the pedes or flukes of cetaceans were once possessed of well-developed phalanges, is the distribution of the dorsal and ventral interdigital arteries, the arrangement of these in fact indicating that there was a great inequality in the length of the digits of the pes, the same as we now see in the manus, thus leading to the conclusion that the foot-structure of the ancestral or protocetacean type was so far different from that of the pinnipeds.

The next step in the process would be the atrophy of the limb-bones and muscles, which, on account of still greater restriction of their movements, would become useless, leaving the integuments of the feet as the flukes on either side of the end of the tail, which, with the total abandonment of the land by the animal, would become stronger and its centra greatly developed, carrying the pedal folds or flukes still farther rearward, and thus increase still more the interval between them and the remnants of the pelvis. At the same time, the muscles of the tail would become greatly developed, so that in the cetaceans we actually have the spectacle of an animal type which has descended from a land form with a degenerate tail again acquiring a tail of the functional importance of that of a fish, but structurally very dissimilar, especially as regards the arrangement of its muscles, which are not homologous with the muscular somites of a fish's tail. The pes thus becomes the only outwardly apparent part of the hind limb, just as the manus is the principal part exserted in the fore-limbs of cetaceans, where some of the muscular insertions have also been shoved outward or into a more distal and effective position. The inclusion of the end of the tail of cetaceans between the flukes has also differentiated the caudal vertebræ of the latter into two distinct and well-marked series, so that the centra, as respects their vertical diameters, do not taper from the sacral region backward, as in other mammals, but only from in front of the flukes backward.

The arrangement of the vessels of the manus and flukes is somewhat similar, but totally unlike that of the vessels entering the dorsal fin, which has only a median system, whereas the flukes have about ten dorsal and as many plantar vessels just under the integument, the prolonged fourth of these, reckoning from the anterior border of the fluke, being the analogue of the prolonged interdigital artery lying between the second and third digits of the manus, and which supplies the end of the flipper with blood, just as the outer two-thirds of the flukes are supplied by the prolonged fourth dorsal and ventral pair spoken of above.

Finally, it may be said that the rudimentary tibia, when present, is directed backward in the cetaceans just as in pinnipeds, showing that if it were fully developed and prolonged it would carry the pedes far behind a vertical line drawn through the hip-joint. There is also other evidence that the inclusion of the hind limbs in the whales has occurred in much the same way as in pinnipeds, for example, the femora are adducted to a remarkable degree in Balæna, according to Struthers, showing that the encroachment of other parts must have been the principal cause of such adduction. The femora of Halitherium seem also to have been directed backward toward the flukes, according to the figures given by Lepsius.

The translocation of the pedes of cetaceans has been accomplished through an extended phyletic series and was not sudden or partially saltatory as in the case of the pelvic limbs of embryo physoclists. The translocation in the first case was due to the backward extension of the limb, outwardly carrying only the pes away from its original place, in the latter the whole limb is shifted together with the girdle. In cetaceans there has been little or no shifting of the pelvic girdle, its detachment from the vertebral column being due to the atrophy of the ilium. The extension backwards of the limbs and pedes parallel with the caudal portion of the vertebral column, obviously began in an amphibious mammalian type and has thus *gradually* brought the pedes to their present position, where they appear ontogenetically; heredity, through immediate ancestry, here, as in many other cases, greatly marring the phylogenetic record. This gradual shifting, according to the method described, completely does away with the difficulty suggested by Flower as to the helplessness of the animals during the transfer, which really began in forms already to a great extent helpless on land but certainly not in the water.

The foregoing gives the principal anatomical and embryological grounds for regarding the flukes of Cetacea as the representatives of pedes translocated backward by rotation and extension of the limb rearward into a position parallel with the tail by the process of inclusion as described above, but as it is impossible to consider the evidence in favor of this conclusion in detail in this brief abstract, those interested are referred to my illustrated memoir on the subject almost ready for publication by the U. S. Fish Commission.—*John A. Ryder.*

PSYCHOLOGY.

INTELLIGENCE OF THE LIMPET.—By far the larger number of limpets "roost" upon rocks whose only covering consists of minute green algæ and millepores, together with numerous acorn barnacles. These last are seen to be of very unequal degrees of "cleanness," some being covered with vegetable growth, others quite white and bare. Those immediately surrounding a limpet or group

of limpets are invariably free from algæ. As might have been anticipated, Patella is the cause of this freedom. At low tide any one on the lookout can hear a quick, regular rasping sound in all directions, and see numerous limpets slowly crawling about. Scrutiny of any particular individual shows that the rasping noise is caused by strokes of the radula, which speedily scrapes away the incrusting algæ. Whilst "on the feed" a limpet moves steadily on, pretty much in a straight line, and continually sweeps its elongated snout from side to side, feeling out probably suitable patches whereon to graze. When such a one is discovered, it is gradually licked quite clean. If the patch happens to be the surface of a moderate-sized barnacle, the circular lip is completely spread over it, almost tempting one to believe that the crustacean is about to be "sawn out." Such, however, is not the case, "house-cleaning" being the sole end in view. Indeed, limpets are often serviceable to one another by thus clearing away esculents growing upon their shells. To secure a dinner, a good deal of licking is requisite, and perhaps this habit may help to account for the inordinate length of the tongue-ribbon. Certainly, it must be used up at a very great rate.

But this is not the only, though I believe the chief way in which the limpet feeds. Those individuals which live near large seaweeds, such as Fucus, feed extensively upon them, as their gnawed condition testifies. I can speak confidently in this matter, having caught more than one limpet in the act. The operation was as follows: The edge of a thick flat part of the thallus was seized by the lip (as a traveler might commence on a colossal sandwhich), and being, I suppose, held firmly by the upper jaw, a semicircular "bite" was gradually excavated by successive scrapes of the radula, the edges of the bite being beveled on the under side. So far as my observations extended, limpets do not feed when covered by water, but always settle down firmly before the rising tide reaches them. The intervals between which any particular limpet feeds seem to be very irregular; but, as a rule, the largest limpets are apparently least fond of long fasts.

In regard to the second point, the locality-sense, great doubt seems to exist in the minds of naturalists as to whether limpets go back to the same place to roost. I believe the question was answered in the affirmative long since by a Mr. King, but, as far as is known to me, he did not publish any details of his observations, and this is my excuse for giving an outline of mine. Following a suggestion of Mr. Murray, I marked a number of limpets with white paint, and made corresponding marks near their "scars" with a view to "keeping my eye on them." As Dr. S. P. Woodward remarks, it seems probable from an *a priori* point of view, that limpets have a settled home, for they occupy scars, often sunk to a considerable depth, which exactly correspond to the outline of the shell. My observations, made on numerous

specimens of various sizes, completely confirm Mr. King's opinion, and the method of marking rendered cases of "mistaken identity" quite out of the question. The greatest distance from its scar at which I noticed a limpet to be, was about three feet; yet this distance, though extremely rough, and covered with barnacles, was retraversed without difficulty. The excursions from the roosting-places were made in any direction where food offered; so there was nothing like beaten tracks formed. But a limpet always returns home before the rising tide reaches it, and invariably roosts with its snout pointing in the same direction. As might be expected, this position is constant only for individuals. As the shape of the scar corresponds exactly with the shape of the shell, comfort, of course, could only be gained, and a firm hold effected by limpets roosting permanently in the same direction on their scars.

The question now arises, what sense is employed by the limpet in finding its way back to its scar? The appreciation of locality displayed is certainly, for so simply-organized an animal, very keen. The sense of sight is, evidently, out of court, for an eye like the limpet's, consisting of no more than a sensitive cup, could do little if any more than distinguish between light of different degrees of intensity. The tentacles seemed at first sight to be extremely likely organs to use for the purpose, and to decide this I excised those of two marked individuals, which were off their scars. One speedily found its way back; the other seemed confused by the operation for several days, but after that time was found on its scar. This shows a remarkable power of memory, unless the scar was found by accident, which is possible, as the individual was near home when the operation was performed.

But even in that case the scar must almost certainly have been *remembered*. Thus the tentacles do not seem to be the means by which home is returned to. The sense of smell then suggested itself, and it occurred to me that one reason why limpets keep on their scars when covered by the water was to prevent the "scent" of the track traversed from being washed off. With a view to determine this the space between a wandering limpet and its scar was carefully washed again and again with sea-water. In spite of this the limpet in question readily found its way back again. Further experiments are, however, needed, on this head, for any ordinary washing would be very ineffective compared with the prolonged soaking the tide would effect in the case of a limpet (like the one just mentioned) living some distance below high-water mark. Still some limpets live so near this last that they are covered but a very short time, and yet these remain on their scars during that time. Hence I think some other motive probably induces them to remain firmly fixed to their scars when under water. Of course they can hold on best when so fixed, and this suggests the most likely reason for the habit, *i.e.*, to avoid

being washed off the rocks by the tide. I am inclined to think that the snout plays some part in helping the limpet to get home, as this organ is extremely sensitive, and certainly plays an important part in discovering suitable food. I intend carrying on more extended observations with a view to the more complete elucidation of this puzzling question in regard to the limpet's locality-sense, but this preliminary notice may possibly be of some interest.—*J. R. Davis, in Nature for Jan. 1, 1885.*

ANTHROPOLOGY.[1]

ELEMENTS OF GENERAL ANTHROPOLOGY.—Without drawing invidious comparisons, it would not be unfair to say that anthropological science is better organized in France than in any other country. The Dictionary of Anthropological Sciences, now going through the press in Paris, is just at this moment followed by a colossal work by Dr. Paul Topinard. The first volume, of 1157 pages, entitled "Eléments d'Anthropologie générale," relates to the history of anthropological investigations and to those special investigations which have been prosecuted upon the human body. The second part of the Anthropologie générale will bring together all the matter furnished by the different branches of the natural history of man, taking into account instructions furnished by accessory sciences, and will make a synthesis of these results, concluding with a discussion of man in time, his origin and his future.

The second volume of the work will be the application of the zoölogic method to the determination of all the types of the human species and of all the races. This will be denominated "Anthropologie spéciale."

Without spending a word in the praise of a work which speaks for itself, we will give our readers a few of the tables not accessible in any text books, but indispensable even to intelligent readers.

The first six chapters are historical, tracing with great minuteness the methods of studying man from Herodotus, Hippocrates, Aristotle and Galen down to the foundation of the Anthropological Society of Paris. The next three chapters, VII, VIII, IX, treat of the methods to employ in anthropological research. The remaining chapters are devoted to the study of the hair, nose, color of hair, eyes and skin, cephalic indices, height, brain-weight, skull-cubage, craniometry, zoölogic characters, æsthetic characters and anthropometry.

In a former number of the NATURALIST we called attention to a fact, often noticed, that the method of the formation of races is in a certain sense antizoölogical. As Professor Flower observes, the methods of the formation of species are necessarily disper-

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

sive, centrifugal. As in the cosmic period heavenly bodies were thrown off by a revolving mass, so have species arisen by that isolation which is necessary to the fixity of hereditable characteristics. There seems to be a growing conviction that the first human stem threw off at least three branches to which the specific law just mentioned applied. But expanding indefinitely the borders of these subspecies, if you like, soon overlapped and set up a concrescent, concurrent movement, resulting in a diversity of races.

Dr. Topinard accepts this tripartite division of humanity, developed by Cuvier and enforced by Flourens and de Quatrefages, but justifies this plan by arguments wholly his own.

Taking the section of the hair or crinal index as a primary classific concept, he gives the table below:

1. Hair straight, section more or less round, scarce on the face and body.	Yellow and red races of Asia and America.
2. Hair nappy or very spiral, section more or less elliptical.	Negro races of Africa and Oceanica.
3. Hair more or less curled or wavy, oval in section.	European races, Australians, Nubians, etc.

The next concept is the nasal index, to which Dr. Topinard attaches great importance. Adding this to the color of the skin we have:

Leptorhines (living) 69 and less	White Races [Leucoid]	Hyperleptorhine		Anglo-Scandinavian (Kymri)
		Leptorhine (non-aquiline)		Celts
		" (aquiline)		Semites
Mesorhines (living) 70 to 81.4	Yellow Races [Xanthoid]	Flat noses	Leptorhine (cranial)	Eskimo
			Mesorhine (cranial)	Yellow races of Asia
		Saliant nose		Red-skins
Platyrhines (living) 82 and above	Black Races [Melanoid]	Well formed nose		African Negroes
		Nose coarse, with enormous alæ		Melanesians and Australians

The nasal index on the living is the ratio between the length of the nose from the root to the outer insertion of the septum and the width outside of the alæ.

The subject of color is further discussed in its relation to the eyes and hair and the races grouped as below:

Eyes, color. 1. Black and blackish, diff. shades (Top. 317).
2. Green.
3. Hazel.
4. Blue and clear of diff. shades, includ. clear gray.

Hair, color. 1. Absolutely black.
2. Dark brown.
3. Clear chestnut.
4. *a.* Blond, yellowish.
b. " reddish.
c. " ashy.
d. " clear.
5. Red.

Skin, color. 1. Absolutely black.
2. Brown, shaded with red.
3. Brown, yellowish or olive.
4. Reddish.

Skin, color.
5. Yellow or olive.
6. Yellowish white.
7. Brown white.
8. *a.* Rosy white.
8. *b.* Florid white.
9. Freckled.

By color
WHITE [Leucoid]
- *Blonds.* Anglo-Scandinavians or Kymri.
- Chestnut. Celto-Slavs.
- Brunette. Mediterraneans and Semites.
- Reddish (ruddy). One of the two Finnish types.

YELLOW
- Yellow proper. Races of Asia and Eskimo.
- Red
  - Red proper. Redskins and Caribs.
  - Yellowish red. Guaranis, Botoceodos.
  - Olive red. Peruvians.
- Blackish. Charruas (Uruguay); Anct. Cal., So. Dravidas.

BLACK
- Yellowish. Hottentots.
- Reddish. African Negroes.
- Blacks proper. Australians, Blacks of India; Tasmanians and Papuans, Negritos, African Negroes.

The cephalic index is the ratio of the greatest skull width divided by the greatest skull length. As to the boundaries of the terms applied to these ratios, most unhappily the doctors disagree. Dr. Topinard's table is as follows:

Dolicocéphaly. 74 per cent and less.
.64 and less Ultradolicocephaly.
.65–.69 Dolichocephaly.
.70–.749 Subdolichocephaly.

Mésaticéphaly. 75 to 79.9 per cent.
.75, .76 Sub——.
.77 Medium.
.78, .799 Super.

Brachycéphaly. 80 per cent and over.
.80 to .84 Sub——.
.85 to .89 Super.
.90 and over Ultra.

In addition to these the following terms are in use:

Acrocephaly. Skull high in proportion to the width.
Oxycephaly. Skull in shape of sugar-loaf.
Platycephaly. Noting flat skulls.
Chamæcephaly. Noting low skulls.
Stenocephaly. Noting narrow skulls.
Trochocephaly (τροχάω, to be round). Noting spherical skulls.
Macrocephaly. Noting large skulls.
Microcephaly. Noting small skulls.
Plagiocephaly. Noting oblique skulls.
Cymbocephaly. Noting skulls with hollow bregma.
Scaphocephaly. Noting skulls with keel-shaped crests.
Sphenocephaly. Noting wedge-shaped skulls.
Trigonocephaly. Noting triangular skulls.
Pachycephaly. Noting skulls with thick walls.

The application of the cranial index to the divisions of the human species previously considered, results as follows:

I. White races
- Dólicho — Anglo-Scandinavians, Franks and Germans. Fins of one type, Mediterraneans.
- Mésati — Semites, Berbers, Egyptians.
- Brachy — Celto-Slavs, Ligurians, Laps.

II. Yellow races	Dólicho	Eskimo, ancient Tehuelches, some Americans, Santa Barbara, Mecronesia here and there; in Asia here and there, Melanesians.
	Mésati	Polynesians.
	Bráchy	American type, Alaska Siberia, Mongols, Mantchoos, Indo-Chinese Dravidians, Thibetans, Malay.
III. Black races	Dólicho	Australians, Veddahs and congeners, typical Melanesians, African Negroes, Bushmen.
	Mésati	Tasmanians, Mandingos, Haoussas.
	Bráchy	Negritos of Malaysia and the Andamans.

It will be readily seen that the cranial index in its three branches applies to each of the three divisions of humanity (subspecies), the significance of which seems to be that the tendency to pass from one to the other belongs to the whole species rather than to any of its three divisions.

In this résumé we shall have space to mention but one other characteristic, stature:

Nomenclature of Stature.

Tall	men	1^m, 70 and above,	women	1^m, 58 and above
Ultramedium	"	1^m, 69 to 1^m, 65	"	1^m, 57 — 1^m, 53
Inframedium	"	1^m, 65 — 1^m, 60	"	1^m, 52 — 1^m, 40
Short	"	1^m, 60 — below	"	1^m, 39 — below

Combining this mark with all previously mentioned, Dr. Topinard groups the races studied as follows:

Vivo-nasal Index.	*Hair.*	*Cranial Index.*	*Skin Color.*	*Height.*	*Races.*
White subspecies. Leptorhine	Wavy (oval sec'n)	Dolichocephalic	Blond	Tall	Anglo-Scandinavians
			Ruddy	Tall	Fins, type I.
			Brown	Short (relative)	Mediterraneans
		Mesaticephalic	Brown	Short (relative)	Semites, Egyptians
		Brachycephalic	Brown	Short	Laps, Ligurians
			Chestnut	Medium	Celto-Slavs
Yellow subspecies Mesorhine	Coarse, straight round-section, long on the head, body glabrous	Dolichocephalic	Yellow	Short	Eskimo
			Reddish	Tall	Tehuelches
		Mésaticephalic (.76)	Reddish	Tall	Polynesians
		Brachycephalic	Reddish	Tall	Redskins
			Yellow	Short	Yellow race (of Asia)
			Yellow'h	Medium	Guaranis
			Olivish	Short	Peruvians
Black subspecies Platyrhine	Bushy (oval section)	Dolicocephalic	Black	Tall	Australians
	Wooly (elliptical section)	Dolichocephalic	Yellow'h	Very short	Bushmen (steatopygians)
			Black	Tall (eyebrow salient, nose deep at the root)	Melanesians
			Black	Tall	African Negroes
		Mesaticepalic	Black	Medium	Tasmanians
		Brachyceph'ic	Black	Short	Negritos

In a future number of the NATURALIST it may be advantageous to give Dr. Topinard's instructions about taking measures on the living.

MICROSCOPY.[1]

SOME ANATOMICAL AND HISTOLOGICAL METHODS.[2]—*I. A modification of Semper's method of making dry preparations.*—While it may be true that in many cases the preparations made according to Semper's method have an appearance similar to a gypsum model, they quite often present a dingy, weatherbeaten aspect that is by no means agreeable. The thin membranes and the connective tissues of dissections are left in a loose, wooly condition that grows worse by handling.

The microscopist completes his work by mounting his preparations in a solution of balsam. In like manner Semper's method may be completed by saturating the preparation with some solid that would fill up the pores, bind the parts together and restore the natural appearance. The solid which I have employed for this purpose is a mixture of Canada balsam, paraffine, and vaseline, but it is probable that a soft paraffine will in most cases do quite well. It is necessary that the mixture shall melt at about 46° C. (115° F.). It will be seen that the preparation is treated just as the microscopist treats an object when he wishes to obtain a consecutive series of sections. While yet saturated with the turpentine, it is to be immersed in the mixture, heated a little above the melting point and kept there until all the turpentine has been replaced. In many, if not in most cases, however, the turpentine may be allowed to evaporate before the preparation is put into the melted paraffine mass. The latter then quickly penetrates the tissues and the work is simplified. The preparation is then to be kept in an oven vessel warm enough for the excess of paraffine to melt and drain off. It may then be wrapped in cloths or in bibulous paper until the whole of the paraffine mixture adhering to the outside has been dried off.

The advantages to be derived from pushing the process to this stage are the attainment of a greater degree of firmness and strength in the specimen, the obviation of the bleached appearance assumed on the escape of the turpentine, and the restoration of the natural colors. Probably any colors will reappear that will endure immersion in alcohol. In the case of anatomical preparations made in the way described, injected vessels show to advantage. I have also prepared specimens of lizards, small turtles, fishes, mussels and earthworms; and whenever the tissues have been thoroughly saturated with the wax mass, the results have been satisfactory.

II. A method of making double injections for dissecting purposes.—A brief notice of Professor H. F. Osborn's method for double injections appeared in *Science Record*, II, Feb. 15, 1884, p. 84. His plan appears to have been to fill the whole vascular

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.
[2] By Professor O. P. Hay, Indianapolis.

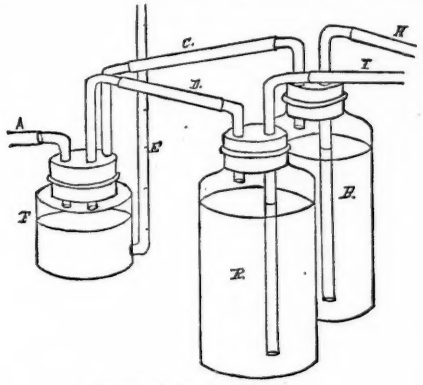
system with a thin colored injection mass, as in making an ordinary injection. When this has passed through the capillaries and well filled the veins, there is forced into the artery a differently colored *plaster mass* which pushes the previously injected thin mass before it until the plaster has reached the capillaries, where its onward movement is arrested. For a year or more before Osborn's notice was published, double injections based on the same principle had been made by the writer. As practiced by myself, a canula was fitted into the aorta of a cat, and a gelatine mass colored with carmine was injected until it was seen to flow from the right side of the heart; then the tube conveying the red mass being detached, a tube conveying a blue gelatine mass was slipped over the same canula, and the pressure again applied. Into this blue mass had been mixed thoroughly a quantity of starch, preferably from wheat. This starch-bearing mass pushed the carmine mass before it until the starch grains entered the capillaries and effectually plugged them up. The arteries were thus left blue and the veins red, and so well was the work accomplished that a lens of considerable power had to be used to discover any admixture of the colors in the smallest vessels of thin membranes. The first mass injected need not be unusually thin.

The capacity of the capillaries is so great, as compared with that of the arteries, that any commingling of the two colors is concealed in them. Carmine is used for the veins because of the ease with which it may be prepared, its permanence and the facility with which it passes through the capillaries. On the other hand, the gelatine for the arteries may be colored with the coarser pigments, such as Prussian blue or ultramarine. The latter furnishes a beautiful blue. Vermilion is not suitable for the first injected mass, since on account of its high specific gravity it readily sinks to the lowest side of the vessels, drags behind, and causes a commingling of the colors. An additional reason for filling the veins with red rather than with blue is found in the agreeable and natural color given to the preparation.

Of course a mass of plaster of Paris injected after a gelatine mass will drive it until the plaster reaches the smallest vessels, thus producing a double injection. The starch mass recently proposed as a filling for blood-vessels will readily lend itself to the production of a double injection according to the method detailed above.

III. A method of producing double injections for histological purposes.—So far as I am aware the usual method of producing a double injection of the blood-vessels preparatory to making sections for the microscope, is to inject first a gelatine mass of one color into the artery until the increasing pressure gives notice that the mass is entering the capillaries, and immediately after to inject a differently colored mass into the vein. The injection be-

ing thus accomplished one of two things, it seems to me, is likely to happen; either the vessels will not be well filled or the mass intended for one set of vessels will be driven through into the other. To avoid these accidents I have practiced the method of filling both sets of vessels at the same moment and under exactly the same pressure. This pressure is kept low at the beginning so that all the arteries and veins shall be thoroughly filled before either mass begins to enter the capillaries. Then as the pressure is increased the differently colored masses meet each other in the capillaries; and if the pressure on each is equal, the vessels may be filled as full as compatible with safety without danger of either color being driven from one set of vessels into the other. The way in which this result is accomplished will be understood better by reference to the accompanying drawing. The desired press-



Double-Injecting Apparatus.

ure is secured by allowing a stream of water from a hydrant or from an elevated cistern to flow into a tight vessel. A two gallon petroleum can does quite well. As the water flows in the air is forced out through a rubber tube, *A*, into the wide-mouthed bottle, *F*, whose tightly fitting cork gives passage to two other glass tubes. These extend below just through the cork and above connect respectively with the rubber tubes *C* and *D*. Into the side of *F*, near the bottom is fitted another tube, *E*, reaching to a height of ten inches or more, open above, and graduated into inches. If preferred, this tube may also pass through the cork and extend down well into the mercury with which *F* is partly filled. *B* is a bottle of suitable size in which is contained a blue injection mass for filling the veins, and *R* a similar bottle containing a red mass for the arteries. The interiors of these bottles are connected with the bottle *F* by the tubes *D* and *C*. Each of the bottles, *B* and *R*, has a tube which, starting from near the bottom, passes through the cork, and is, a little above this, bent at right angles. With these are connected the rubber tubes, *H* and *I*.

Now when water is allowed to flow into the reservoir mentioned above, the air is forced out through *A* into *F*, and thence along the tubes *D* and *C* into *B* and *R*. As soon as the pressure in these bottles becomes sufficiently great, the liquids which they contain will be driven out through the tubes *H* and *L*. If there should be any obstacle to the escape of these fluid masses, the pressure in all the vessels will rise and be registered by the height of the mercury in *E*.

If now it is desired to inject, for instance the kidney of a pig, a canula made of a glass tube must be fitted securely into the renal artery and a similar one into the renal vein. The canulæ must be of such a size that the rubber tubes, *H* and *I*, will fit them well. Heat the gelatine masses in the bottles, *B* and *R*, to the proper temperature and keep them so heated until the injection has been finished. Special care must be taken with the tubes, *H* and *I*, to prevent the gelatine passing through them from becoming frozen. Now having clamped the tube, *H*, have an assistant turn on a small stream of water until the gelatine begins to flow slowly from *I*. If the diameter of the canula is not too small it may be held with the free end directed upward and filled with gelatine allowed to drop from the mouth of *I*. Then slip *I* over the canula. Unclamp the tube, *H*, and when the gelatine from *B* has begun to flow, slip it over the canula inserted in the vein. Then increase the pressure gradually until it has reached as high a point as experience has taught to be safe for the organ operated on.

By means of this apparatus, which will require the expenditure of only a few cents and a little ingenuity, double injections may easily be made of any organs whose veins are not provided with valves. I have made injections of the kidney whose arteries and glomeruli became uniformly filled with the red mass and whose veins and the system of capillaries surrounding the renal tubules became filled with the blue. The lungs and the liver are easily and successfully injected. I have been less successful in injecting the organs that send away their blood current through the portal vein; but I have no doubt that they too may be injected.

Triple injections of the liver may be made by first injecting the hepatic artery with a green mass until the whole liver assumes a green tint, and afterwards injecting the portal vein and the hepatic vein with red and blue as above directed.

The same apparatus may be employed to make either single injections or the double injection described under the second head of this paper, by simply clamping one of the tubes, *C* or *D*. As a matter of course care must be taken that all the corks fit tightly in the bottles, otherwise the internal pressure may force them out at the very moment when an accident will do the most damage.

SCIENTIFIC NEWS.

— Titian Ramsay Peale died in Philadelphia, March 13. He was the last surviving son of Charles Willson Peale, the famous portrait painter of Revolutionary times. For the past ten years he has resided in Philadelphia. He was born in October, 1799. He was an enthusiastic naturalist, and was noted for his collections of moths and butterflies. He was one of the founders of the Philosophical Society of Washington, and was the sole survivor of Col. Long's celebrated "Expedition to the Rocky mountains," to which he was attached as assistant naturalist. He was also one of the naturalists with the U. S. exploring expedition of Commodore Wilkes.

— The Sea-side Laboratory, at Annisquam, Mass., will be open to students during the coming summer from July 1st to Sept. 1st, 1885. The instruction and work of the laboratory will be under the immediate care of Mr. B. H. Van Vleck, assistant in the laboratory of the Boston Society of Natural History. Applicants should address Professor A. Hyatt, curator of the Boston Society of Natural History.

— The Mexican government has appointed a commission for the scientific investigation of the natural products of the country. It includes a number of gentlemen who reside in different parts of the republic. The president of the commission is Dr. Fernando Ferrari of the city of Puebla.

—W. Curtis Taylor, 1328 Chestnut street, Philadelphia, has taken a series of composite photographs of the officers of the American Association for the Advancement of Science of 1883–4. They compare favorably with those of the National Academy of Sciences taken in 1883.

— Dr. F. Ritter von Stein, professor of zoölogy in the University of Prague, well known for his beautifully illustrated and elaborate works on the genital organs of insects and on the Infusoria, died in February last.

— Mr. E. C. Rye, of London, well known as a coleopterist, and the editor of the *Zoölogical Record*, died Feb. 7th, aged 52. He was a man of versatile talents, and a pleasant person to meet.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington, March 7. — Communications were made by Dr. C. A. White on the use of gutta-percha in making casts of fossils; by Dr. H. G. Beyer, U.S.N., re-

port on intracellular digestion and its relations to pathology; by Mr. G. Brown Goode, remarks on the velocity of animal motion.

March 21.—Communications were made by Mr. Wm. H. Dall on the Marsupium of Milneria; by Prof. J. W. Chickering, Jr., exhibition of some botanical drawings and paintings; by Dr. Tarleton H. Bean, some features of collecting at Cozumel island, Yucatan; by Dr. J. A. Ryder, on the development of the mammary glands in the Cetacea; by Mr. Lester F. Ward, phyllotaxy of *Paulownia imperialis.*

New York Academy of Sciences, March 2.—The following paper was read: Meteorological and hypsometrical notes in the islands of the Curaçao group, West Indies, by Dr. Alexis A. Julien.

March 23.—The following paper was read: Notes on building-stones (with illustrations), by Mr. Arthur H. Elliott.

March 30.—The following paper was read: On the trigonometric and topographic surveys of the United States (illustrated by lantern slides, and the exhibition of instruments actually employed in the field), by Prof. Wm. P. Trowbridge.

Boston Society of Natural History, March. 4.—Dr. E. G. Gardiner spoke of the development of the bill and epidermis in the chick.

March. 18.—Mr. C. E. Ridler read papers on some of the rare plants of Kingston, Mass., and on some ancient stone implements from the same locality.

American Geographical Society, March 19.—Mr. Ernest Ingersoll delivered a lecture entitled, How the settlement of North America has affected its wild animals.

Appalachian Mountain Club, March 11.—The following papers were presented: Some of the hills of Plymouth county, by C. E. Ridler; altitudes in Massachusetts, with a sketch of the Massachusetts trigonometrical survey conducted by Simeon Borden, 1830–1840, by E. G. Chamberlain; a week in the Pemigewasset wilderness, by Rev. H. P. Nichols (read by R. F. Curtis).

Special Meeting, March 20.—An ascent of Ben Nevis, illustrated with a few lantern views, was presented by A. E. Scott; a trip from the Connecticut lakes to the Rangeley lakes, was read by R. B. Lawrence.

Philadelphia Academy of Natural Sciences, Jan. 27.—Miss A. M. Fielde gave the results of a series of experiments upon the power of regeneration of lost parts possessed by earthworms

(Lumbricus). Fifty-eight days after decapitation the worm had reproduced not only the brain, but the œsophageal collar and œsophageal ganglion. In one of the specimens exhibited, the lobes of the brain-mass were about one-half of the normal size; a second had progressed further, while in a third the brain and ganglion were normal. The only perceptible difference between the regenerated ganglion and the original brain was a somewhat paler color.

Feb. 17.—Miss Fielde stated that when twenty or more segments, constituting the posterior portion of a worm, were cut off behind the clitellum, regeneration never took place at the cut end, but by the insertion of new pieces. Mr. Meehan accounted for the sparse distribution of the cedar of Lebanon by attributing it to the solidity of the cones, which never open, though the seeds are winged, and therefore designed for wide distribution. He believed it probable that this close habit of the cones has only existed in comparatively recent times. The Indian species is so closely related that it probably sprang from the same ancestral stock. The only young trees which grow in a state of nature are produced from cones which rot in rock-crevices or are broken by accident. Professor Heilprin read a paper upon disputed points in geology and palæontology, with special reference to the greater adaptability of the lower forms of life to changed surroundings, and their consequent persistence in later geological deposits, as compared with the rapid extinction of higher types. Arguments were adduced in favor of homoplassy in evolution or the origin of the same generic or even specific forms by distinct lines of ancestors, and the reappearance of extinct genera and species in subsequent geological epochs.

Feb. 26.—Mr. Potts described a new Hydrozoan from Tacony creek. This creature has a cylindrical body, surrounded at its free extremity by sixty or seventy papillæ, but without tentacles. Very long lasso-threads are present. The usual length of the creature is about $\frac{1}{60}$ of an inch. The ectoderm is an almost homogeneous hyaline substance filled with large cells. It was thought that a clear central space had been seen, and that a faint channel ending in a mouth could be traced. This appears to be the most primitive form of Hydrozoan yet described, its power of motion is very slight, and how it can capture prey without tentacles is a mystery. Mr. Potts suggested that it might be the larval state of a more developed form, as it had not changed, but had budded from the base. Professor Sharp argued in favor of the view that this organism, in common with other fresh-water organisms, has degenerated from a somewhat higher type. Mr. Potts stated that he had received from Pictou Lake, Nova Scotia, specimens of the statoblasts of a new species of sponge. Specimens collected just before Christmas indicated that it was an evergreen species.